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ELECTRICAL TOWER OF THE PAN-AMERICAN EXPOSITION.—JOHN GALEN HOWARD, ARCHITECT.

THE ELECTRICAL TOWER AT THE PAN-AMERICAN EXPOSITION.

By Edward Hale Brush.

In the court of the splendid office building in Buffalo known as Ellicott Square hangs an oil painting by that clever and versatile painter and novelist, F. Hopkinson Smith, which depicts the imposing and beautiful electric tower, which is to be so conspicuous a feature of the Pan-American Exposition to be held at Buffalo next summer. This tower will be the most splendid centerpiece that ever adorned any exposition. Its stately presence will dominate the whole scene and emphasize both in the proportions of the tower and in its brilliant illumination at night the leading part which electricity is to play in this first exposition of the twentieth century.

Less elaborate by reason of the absence of color, but perhaps even more impressive in its pure simplicity than Mr. Smith's painting, is the model of this tower, a photograph of which is reproduced in this number of the Supplement. This model, made under the supervision of the architect of the tower, John Galen Howard, gives a vivid conception of the chaste simplicity which the design possesses as a whole, a simplicity which is combined with exceeding richness in carrying out the details of the structure.

The tower will be a thing of beauty by day and a marvel of brilliancy by night. Rising to the height of 375 feet it will be surmounted by a figure symbolical of electricity, called the Goddess of Light. It will be 80 feet square at the base, and in front of it will be a Court of Fountains which, attractive as it will be with its flowers and ornate surroundings by day, will be increased in beauty a hundred-fold at night when colored lights will play upon it and transform the whole vicinity into fairyland. In a niche of the tower facing the Court of Fountains is to be a waterfall 30 feet wide and 70 feet high. All the way up the vast height of the structure will be electric lights, and as the building will be illuminated both within and without, and as the most ingenious contrivances will be employed to produce remarkable effects the resulting appearance will be far beyond the power of words to describe.

There is to be a high class restaurant at a height of 70 feet extending on either side of this upon the roof of the beautiful colonnade, which will thus become a beautiful roof garden and promenade which is sure to be one of the most popular resorts of the Exposition. There will also be promenade floors at various heights and near the summit a balcony from which after ascending to this great height by elevator the tourist can obtain a bird's-eye view of the Exposition, the City of Buffalo, Niagara River and the country surrounding, a sweep of vision covering 60 or 70 miles. The steel framework for the tower is now being delivered and the erection of the structure, which will be an interesting process in building and engineering, has now been begun.

As has been stated, the architect of this remarkable structure is John Galen Howard, of the famous New York firm of Howard, Cauldwell & Morgan. Many architects and engineers have been employed in designing the various sculptural groups or in the engineering problems which the work presents. The sculptors on groups for the tower are: Philip Martini, "The Torch Bearer" and the "Genius of Progress"; A. Weinmann, models for the spandrels, "The Four Rivers"; George Gray Barnard, models of pylons; Herbert Adams, model for brass statue, "Goddess of Light," for the top of the tower; Ralph Goddard, model of seated figure for the tower; Henry Baerer, Louis A. Godebrod, Philip Martini, Carle E. Tefft, models of similar figures; Charles A. Lopez, two groups, "Science" and "Art," for the Court of Fountains; Mr. Tonetti and Mrs. Tonetti, two side fountains, "Birth of Venus" and "Birth of Athene," for the Court of Fountains.

The illumination of this tower will require the use of 250 tons of insulated copper wire of all sizes. Expressed in lineal measure this means a length of wire but little less than 400 miles.

The Chicago World's Fair was a "white city." The Pan-American Exposition at Buffalo will be a city in many colors, and may fancifully be termed the "Rainbow City," for in respect to the brilliant hues of the buildings as well as the fantastic forms of their decorations, it will be a novel departure from traditional exposition architecture. With such eminent men in their respective fields as C. Y. Turner, director of color, and Karl Ritter, director of sculpture, presiding over the work, it may confidently be predicted that both the coloring of the Exposition buildings and the profuse sculptural adornments of the buildings and the grounds will be carried out in so harmonious and artistic a fashion as to produce the most pleasing and elevating effects. It is by the use of the composition called staff that it is possible to obtain these beautiful effects at a cost within the possibilities of an enterprise of this kind. The invention of staff was a great aid in the creation of Exposition buildings beautiful to look upon and at the same time costing but a fraction of what it would require to erect structures of similar beauty but greater permanence of enduring stone. It is a material which is not much used, except when some big enterprise like the Chicago World's Fair or the Pan-American Exposition is in process of construction, and consequently the public in general has little knowledge of the work of making the columns, and panels, and friezes, and capitals, which, with the other exterior covering, also of staff, give the buildings their character and form. There is no permanent craft which is employed continuously in the work of making staff upon a large scale for the obvious reason that the call for its use on an extensive scale is but occasional. For instance, when the work of making staff was begun at Buffalo early this summer, a few skilled workmen were first brought there by the contractors, and the work requiring the most intelligence and skill, such as the modeling of decorations, was done by these men, while green hands were obtained to do the simpler work, and a school of instruction was started. As the work progressed, the new men became more skilled, and now as they handle the beautiful white material, which is moulded into so many fanciful forms, their bare arms and white-suited bodies seem to possess an ease and grace and suppleness of movement as if they had been born to the trade.

The work of placing the staff upon the buildings now in process of construction at Buffalo has begun, and in the shops where the modeling and moulding is done as well as in those under the floors of each large building where the casting goes on a scene of a novel character is witnessed. More than a thousand men will soon be employed upon the grounds in this work alone.

Plaster of Paris and hemp fiber are used in making staff. In the case of the decorations the modeler first makes a free hand design from the general design furnished by the architect, and from this makes a model in clay. Over the model a shell is built, which is coated with shellac and otherwise treated to make it preserve its form. Between the shell and the original model a glue, made of the purest gelatine, is poured, which permeates to the remotest crevice, and when this cools a mould has been created of remarkable pliability and consistency, from which the decoration may be cast. Once the mould is made as many casts can be made as the plans may call for in the supply of the particular architectural member required, for so remarkable in its pliability, and at the same time its firmness, is this mould that it will hold the plaster in place until it dries, and then when removed retains precisely the impression of the original model, so that another cast may be made from it, and another and another. A column or a capital, a cornice or a scroll, even an elaborate ram's head or a delicate arabesque may be duplicated many times from the same mould.

Rows upon rows of these sculptured forms are standing against the supporting pillars of the Machinery, Agriculture, Electricity and other great buildings of the Pan-American Exposition now in process of construction. They are awaiting the finishing touches to be given them, and the moment when the wooden frame work of the buildings has been so far completed that they may be put in the places where they are to be objects of adornment and are to excite the admiration of the millions who will witness the wonders and beauties of the Exposition next summer.

It would take years instead of months to carve from stone the myriad forms of dignity and beauty which thus cast from plastic material will give to the Pan-American Exposition buildings their stately and ornate effect.

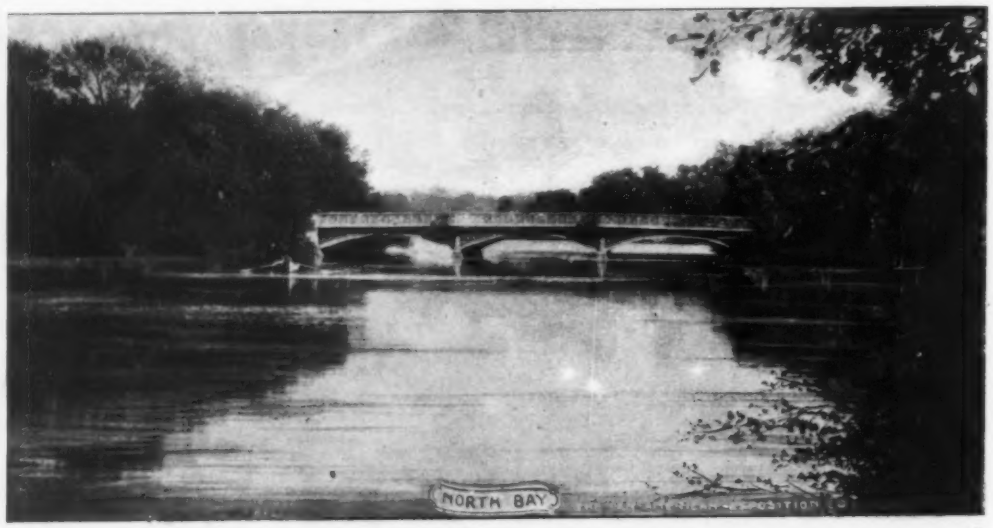
Large quantities of packed meats have been sent from the Union Stock Yards at Chicago to the Orient, for the use of the armies of the Allies.

VIEWS OF THE PAN-AMERICAN EXPOSITION.

THE PARK LAKE.

The beautiful lake here illustrated is about half a mile in length and is within the grounds of the Pan-American Exposition to be held in Buffalo in 1901. The scene is in the most picturesque portion of Delaware Park, which is considered one of the finest in America. The lake is one of a number of fine water features of the Exposition, and is to be illuminated in a novel way at night by countless electric lights. The wooded slopes and shady walks that surround it are restful retreats, and the quiet lake scene is ever picturesque and refreshing. The picture is taken from a point near the west end of the lake, a few rods northeast of where the broad driveway from the main southern entrance crosses a narrow neck in the lake. A macadam drive follows the bluff along the north side, at the left, and a viaduct over Delaware Avenue connects the Meadow Park from the lake section. Upon this portion of the park many thousands of dollars have been expended in improvements. The shrubs and trees include many of the rare decorative species and varieties, and a profusion of flowers is always to be seen along the drives and walks throughout the summer. The main buildings of the Exposition are directly north of the point from which the view is taken.

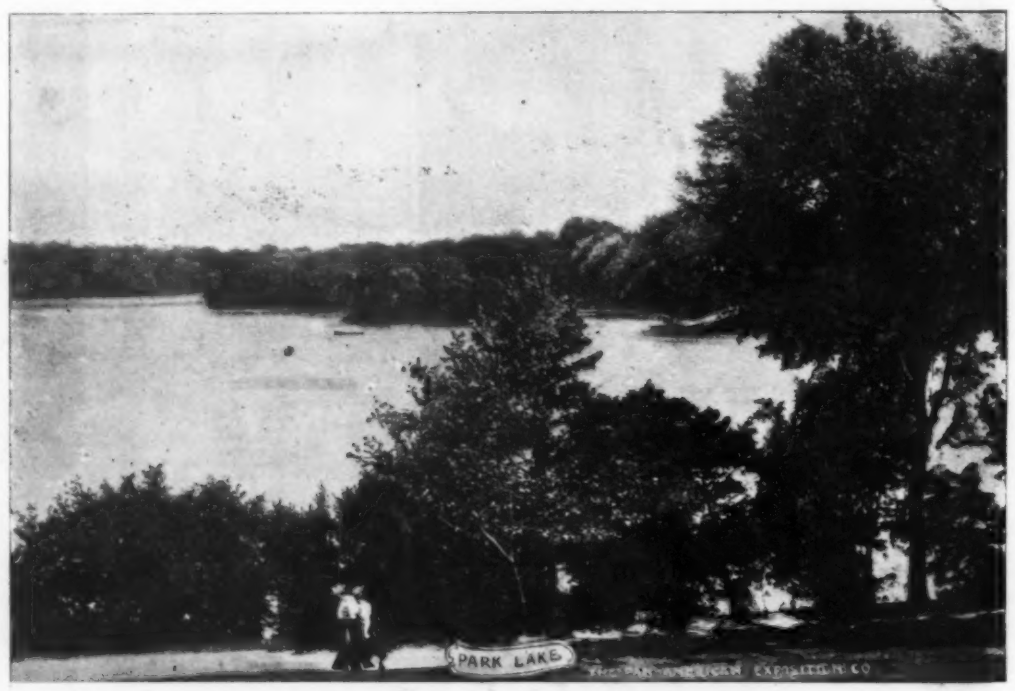
The lake is to be connected by a series of small cataracts with the grand canal, mirror lakes and lagoons that surround the Exposition building.



THE PAN-AMERICAN EXPOSITION—THE NORTH BAY.

THE NORTH BAY.

The view here shown of the North Bay of Delaware Park, which is included in the site of the Pan-American Exposition, to be held at Buffalo next year, is taken from a point north of the site of the Albright Art Gallery. This is destined to be, in view of its magnificent surroundings, in the near future, one of the most beautiful reaches of water in the country. The bridge in the picture, graceful and substantial as it is, is to be replaced by a far more imposing and ornate structure. The bridge crosses a narrow neck in the park lake, and carries the broad and beautiful driveway which leads from the main southern entrance at Forest Avenue to the Exposition buildings. On the north side of the North Bay will stand the fine substantial and permanent building to be erected by the State of New York, and which will become, after the Exposition, the home of the valuable collection of



THE PAN-AMERICAN EXPOSITION—THE PARK LAKE.

Indian, colonial and pioneer relics and library owned by the Buffalo Historical Society. Opposite the New York State building, on the south side of the bay, will stand the Albright Art Gallery, which is to serve the purposes of the Exposition for the Department of Fine Arts. This building is the gift of Mr. J. J. Albright, of Buffalo, to his fellow citizens. It is to be strictly fireproof, of white marble, in the Ionic style of architecture, and will stand on a broad terrace sustained by a wall of granite blocks. The building will be 250 feet long by about 159 feet wide, and is to be of such a substantial character as to withstand the elements for many generations. It will become the public art gallery of Buffalo at the close of the Exposition, the Buffalo Fine Arts Academy having the custody of the property.

THE PAN-AMERICAN EXPOSITION—THE ART PALACE.

THE ART PALACE.

The city of Buffalo is soon to have one of the most beautiful buildings in the Western world, a public art gallery, to cost upward of $350,000. The building is the gift of J. J. Albright, a citizen of Buffalo and a liberal patron of art, who desires to bestow upon his city a structure that will forever yield immeasurable pleasure to those who visit it, and become, as well, a center of culture and art. The only conditions imposed by the public-spirited donor were that the city of Buffalo should furnish a site, and that the Fine Arts Academy of Buffalo, which is made the custodian of the property, should raise a maintenance fund of $100,000. The city promptly deeded the site requested, which is just within the limits of Delaware Park, overlooking the beautiful park lake. The Fine Arts Academy has complied with the terms of the gift as they applied to the maintenance fund, and the building will be hurried to completion as rapidly as conditions will permit. The building will be used as the Art Palace of the Pan-American Exposition, and thereafter become the permanent home of Buffalo's art collections.

The magnificent edifice will be 250 feet long by 150 feet wide, the principal façade looking toward the east. The building will stand upon a broad terrace 35 feet above the level of the park lake, which lies but a few rods below and to the eastward. The principal approach will be by a beautiful monumental flight of steps, the contour of the ground giving opportunity for stately embellishment. The terrace walls are to be of heavy granite blocks. Statuary, fountains, formal floral displays and lawns will complete the ornamentation of the terrace.

The style of architecture chosen is the classic Greek, both the eastern and western façades showing rows of rich, graceful columns. The style is Ionic. A semicircular colonnade forms the central figure of the west or Elmwood Avenue front. The building has broad wings at the extreme northern and southern ends, terminated by porches which will be reproductions of famous architectural works of ancient Greece. The highest peak is only 45 feet above ground. The Erechtheum of Athens has been a prolific source of inspiration for the architects, Messrs. Green & Wicks, of Buffalo. The portico of the Erechtheum, famous for its caryatides, will be one of the works to be thus reproduced. The Erechtheum was an ancient temple and is one of the most interesting of the ruins of the Acropolis at Athens. It was rebuilt after the Persian invasion, about 400 B. C.

THE PAN-AMERICAN EXPOSITION—NEW YORK STATE BUILDING.

Entering the building by way of the main approach one comes first to the hall of statuary, in the middle of the building, which is 71 by 100 feet. Directly west of this is the Hemicycle, a large semi-circular room with tiers of seats and a rostrum, where lectures may be given before audiences of several hundred people. North of Statuary Hall will be a gallery 35 by 58 feet. On either side of the corridor leading to this gallery are library and board rooms. Beyond, in the extreme north wing, will be seven studio rooms, connected by a long corridor. In the western part of the building are two ante-rooms and four large galleries. In the large, light basement will be numerous other rooms for all sorts of uses in connection with the proper management of the building, such as bicycle and cloak rooms, lavatories, janitor's quarters, electric lighting and heating, packing and storage. The building will be strictly fire-proof, the materials being white marble, steel beams, brick, cement and stone. The structure will require 25,000 cubic feet of marble. All materials will be of the best, so that an enduring edifice may remain when present generations shall have vanished.

NEW YORK STATE BUILDING.

The New York State Building at the Pan-American Exposition, to be held at Buffalo in 1901, is to be an edifice of substantial and enduring character. The architect is Mr. George Cary, of Buffalo. He has chosen for his guidance in the work a Greek temple of the Doric order, adapting his plans to the purposes for which the building is intended. The site chosen is on high ground near Elmwood Avenue, overlooking the North Bay of the lake in Delaware Park and near the principal entrance to the Exposition grounds by street cars. The location is not only thus convenient to the electric cars, but one that is fortunate and beautiful as well from every standpoint, so that the building will add to the beauty of this popular pleasure ground. Immediately in front and across the park bay the Albright Art Gallery will stand as a companion piece in the park picture. The building will be used during the Exposition as New York State headquarters, and will contain certain of the State exhibits.

After the Exposition it will become the permanent home of the Buffalo Historical Society, whose large collection of pioneer and other historical relics will be placed therein. The floor area will be three times that now used by the Historical Society in the building of the Buffalo Public Library.

The dimensions of the building are 130 by 82 feet, the north front to be 20 feet less than the south. The height is 33 feet on the north and 40 feet on the south walls. The height of the basement is 12 feet, and the second floor walls reach to the roof, making the ceiling 18 feet high. In the basement are janitor's quarters and bicycle rooms (which may be entered at grade from Elmwood Avenue), boiler and coal rooms, storage rooms, etc. A dining room, containing 1,906 square feet, faces the park to the south and opens on the north. On the ground floor is also one of the museum rooms, which communicates with the floor above by a grand staircase. Over 10,000 square feet of floor space is provided for museum purposes. There is also an Assembly Hall with seats for 300 persons, and a Library 37 by 52½ feet. Officers, cloak and other rooms make the total floor area 31,803 feet. Fire-proof materials will be used throughout in the construction of the building. The exterior will be stone. There will be no wood except the mahogany doors on the first and second floors and birch in the basement. All the door casings, inside column covering and cornices, are of plaster. All bases are marble and cement. The floors are marble, concrete, granite and wood blocks laid in asphalt. The stairways are of marble and iron. The view of the bay and lake and of the park, which will be seen from the broad columnated portico on the south side of the building, will be of the most beautiful character.

AUSTRALIAN IRRIGATION FARMS.

SOME irrigation experiments of a remarkable character are at present being conducted in New South Wales. As is generally known, there is an immense inland region, used exclusively for pastoral purposes, embracing an area of several thousand square miles, and graphically described as a waterless country, the rainfall being slight, and the water supply extremely precarious. Yet it was not until within the last few years that it was definitely shown that abundance of water could be obtained, not only from the cretaceous formation, but also from other rocks underlying the soil in this part of the colony. Artesian boring in New South Wales commenced in 1879, in which year operations were begun at Kallara, a station lying between Bourke and Wilcannia. The supply was tapped at a depth of 140 feet, and the effluent water rose to a height of 26 feet. In 1884 the colonial Department of Mines put down its first bore in search of water, a small supply of which was reached at 89 feet. Since then much work has been done, both by the Government and by private enterprise. On November 30, 1899, there were 73 completed Government bores, while 12 were in progress, and contracts had been let for others. Of those completed, there are 48 flowing, yielding a supply of approximately 29,000,000 gallons per diem, and 16 from which a supply of 750,000 gallons per diem can be pumped; but in the remaining 8 bores the search for water suitable for drinking purposes has been unsuccessful. The deepest bore sunk in the colony is that at Dolgelly, on the road from Moree to Boggabilla, which is down 4,086 feet, yielding a flow of 745,200 gallons per diem. The next in depth is the Bancanya bore on the Silverton-Cobham road, being 3,615 feet deep. The largest flow has been obtained at the Toolora bore, on the road from Walgett to Coonamble, which yields approximately 3,000,000 gallons per diem. The water from the Government bores, over and above that required for traveling stock and domestic use, is being used for irrigation purposes, and much has already been accomplished in this direction. At the Pera bore, 8 miles from Bourke, on the Wanaaring road, an area of 683¾ acres has been reserved for an experimental farm. The remainder of the land has been cut up into 20-acre blocks, all of which have been let under the homestead selection provisions of the Crown Lands Act of 1895.

Should future results realize the anticipations formed by those who have carefully studied the question, it is possible that the vast expanse of treeless, waterless country, at present given up to sheep, and which is a source of heavy loss to pastoralists during prolonged periods of drought, may become studded with richly fertile spots.

The system of soil aëration now adopted is said to have proved successful in every respect, and where, only a few years ago, there was nothing but dry, burnt-up country, may now be found beautiful gardens, filled with the choicest flowers, growing in luxuriant profusion, and orchards filled with healthy trees giving the

rich promise of future abundant crops. But there have been varying results on the irrigation farms. Several have been successful, and others only partially so. This, however, has been occasioned largely by the character of the tenants. Those possessing real agricultural experience and willing to turn it to the best account, have found irrigation farming a remunerative enterprise.—Journal of the Society of Arts.

TRANSMITTER USING THE SINE WAVE FOR CABLE TELEGRAPHY.*

By Albert C. Crehore, Ph. D., and George O. Squier, Ph. D.

This paper describes a method of utilizing the sine wave of electromotive force for cable signaling, and a practical cable transmitter employing these principles. The employment of a sine wave electromotive force makes available the ordinary methods of measurement such as are used on power transmission lines, and some results are given of such measurements upon submarine cables.

The present method of operating long cables employs a primary battery as the source of power, and a siphon recorder to record the signals. In this system a dot is transmitted by a positive current obtained by connecting one pole of the battery to the cable and the other to the earth, and a dash by a negative current connecting the opposite pole to the cable, the time required for a dot and a dash being the same.

Several letters of the alphabet require two or more consecutive signals in the same direction, and in order to separate these successive signals at the receiver it is usual to connect the cable to earth during the latter portion of each individual signal. The electromotive force employed in transmitting the letters *A*, *B* and *C*, is shown in Fig. 1, where it is seen that the cable is directly connected to earth during one-fourth of each signal. This represents the form of electromotive force as furnished by the battery and transmitter, and if no condensers were used would be the form of wave applied to the cable; but it is usual to employ condensers at each end of the cable whether working simplex or duplex, and these condensers greatly modify the shape of the electromotive force, which is applied to the cable itself, as will be shown later.

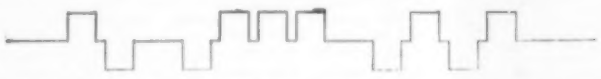


Fig. 1.—Letters A, B, and C. Battery form of electromotive force wave.

Fig. 2.—Letters A, B, and C. Sine wave electromotive force.

It is important in designing a sine wave transmitter to make an instrument which transmits to the cable the same combinations of impulses as those at present employed in cable signaling, so that as far as the receiving station is concerned there is no change whatever required either in instruments or technical staff. The difference between the ordinary and the sine wave method is in the shape of the electromotive force employed for each individual signal at the transmitting end of the cable. In the sine wave system instead of the square topped form shown in Fig. 1 each signal consists of a single sinus or semi-wave of alternating current, as represented in Fig. 2.

The diagram, Fig. 3, represents a method of producing the required combinations of signals by means of a dynamo alternator. The armature rotates continuously, and a wheel, *W*, geared to the alternator shaft, feeds the paper tape, *T*, in synchronism with the electromotive force generated, so that one semi-wave of electromotive force is generated during the time that the tape is advancing a distance equal to the distance between the centers of two consecutive feed holes. The transmitting tape is similar to the ordinary tape, having a row of perforations on one side of the feed holes to transmit dots, and on the other side for dashes. Brushes are employed for making contact through these perforations, and by making the holes a proper size the duration of contact can be made equal to the whole or any portion of the semi-cycle desired. The two brushes for transmitting the signals are on the same line transversely across the tape, and each brush is connected to one terminal of the armature winding through a divided ring, *A*, which causes pulsations of electromotive force to be supplied to the transmitter brushes, *P* and *Q*, consisting of successive semi-sinuses in the same direction. A continuous ring, *B*, is also supplied, which connects the middle of the armature winding to line. The contact, *S*, upon which the three brushes, *P Q*, and *R* bear, is connected to the earth or return. Thus it appears that whenever contact is established on the dot side of the tape between *P* and *S* a positive sinus is transmitted to line, and contact between *Q* and *S* on the dash side sends a negative sinus.

The arrangement just described transmits the proper combinations of signals, but does not provide for discharging the cable between letters and words; for without the brush, *R*, the two brushes, *P* and *Q*, would completely insulate the line from the earth at the ends of letters and words. This earth connection is provided between letters and words by adding to the tape a third row of holes and supplying the third brush, *R*, which connects the line directly to earth whenever a perforation occurs. A sample of the transmitting tape is shown in Fig. 4, where the letters *A*, *B* and *C* are represented. Evidently to send a simple alternating current to line with this transmitter it is only necessary to perforate dots and dashes successively, but the brushes must be so placed that contact through the perforations shall take place at the instants when the current is approximately zero, as will be more fully explained later; otherwise there will be a disturbance which distorts the form of wave from its true sine form.

To adjust the brushes easily they are mounted upon the same carriage which is adjustable along the tape by means of a micrometer screw. This adjustment may be made by receiving the current from an alternating tape on a local siphon recorder which will record a smooth sine wave when the brushes are in proper adjustment. This setting should be made when using the actual cable, not with a local circuit, since the phase of the current is different on different circuits, according to their electrical properties.

The three-hole tape is prepared on a perforator which differs from the ordinary form only in the arrangement of the punches. The operator can detect no difference between its action and that of the ordinary perforator. With a slight change the ordinary perforator can be adapted so as to prepare the three-hole tape.

One peculiarity met in designing a dynamo alternator for working long cables is the low frequency required, which for an Atlantic cable is as low as three or four per second, while the ordinary frequencies of alternators for lighting and power circuits vary from 25 to 150 per second. A means of increasing the frequency is to increase the number of poles of the machine, but if the object is to decrease the frequency in this way the number of poles cannot be less than two. One revolution of an armature in a two pole field gives a complete cycle of electromotive force which limits the speed of the armature to three or four revolutions per second.

In the armatures designed, the reactance even at these low frequencies rather than the resistance, is the controlling factor in determining the short-circuit current, and is so great that the armatures may be short-circuited at any time. The inductance of the whole armature is four times that of the half armature, as the two halves are identical, and the mutual induction between the halves is equal to the self-induction of one half. Since the electromotive force generated by the whole armature is twice that of the half armature, it results that the short-circuit current of the whole armature is only half that of the half armature.

An armature was constructed shuttle wound and gave a form of wave differing greatly from the sine wave, the electromotive force being shown in Fig. 5 as determined photographically by an oscillograph. Drum-wound armatures were made which give very accurate sine waves, as shown by oscillograph records. As will be presently explained, experiment showed a superiority in favor of the sine wave form. Fig. 6 shows a practical sine wave cable transmitter and generator.

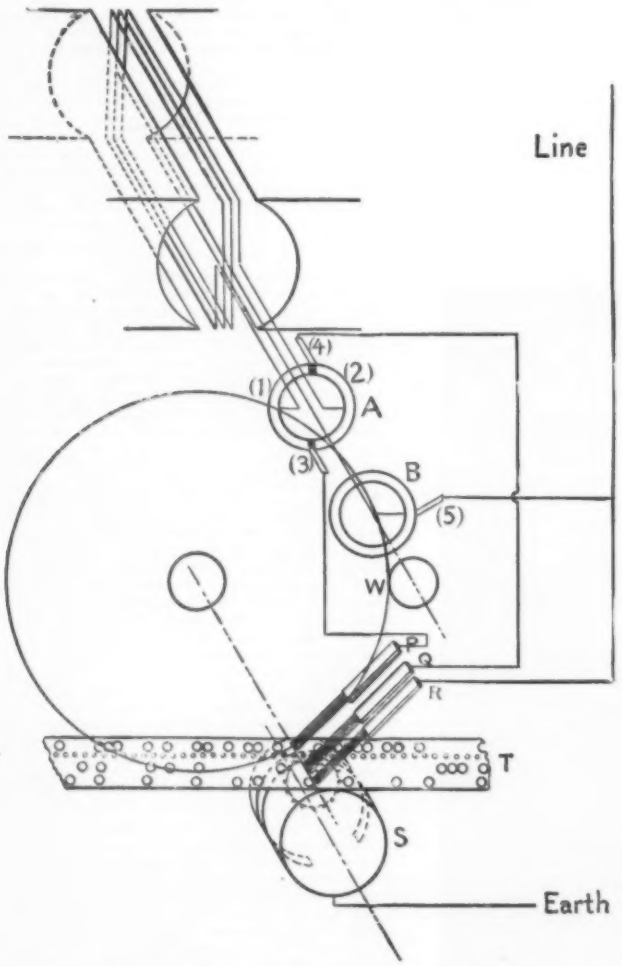


Fig. 3.—Diagram of cable alternator and transmitter.

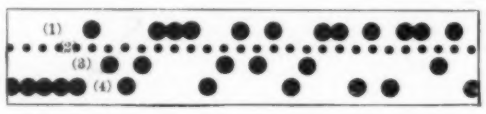


Fig. 4.—Sample of transmitting tape, showing letters A, B, C, D, E, and F. (1) is the dot row, (2) the feeding row, (3) the dash row, and (4) the space row for earthing the cable between letters and words.

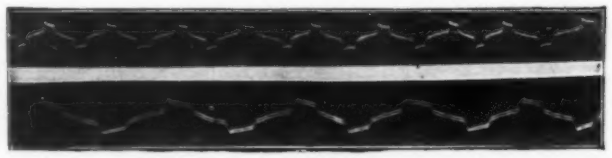


Fig. 5.—Oscillograph record of alternating electromotive force obtained from a shuttle wound armature in a two-pole field.

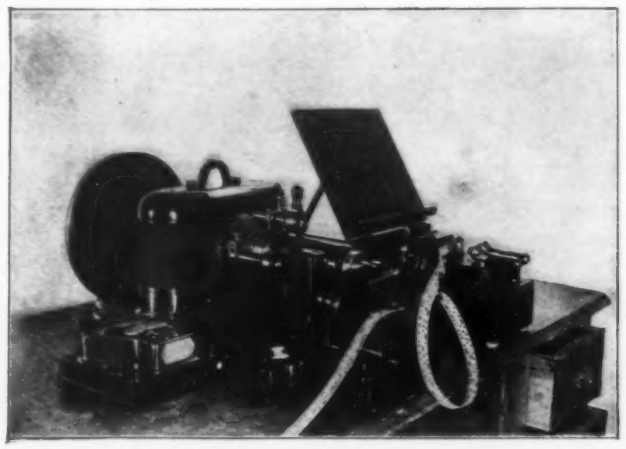


Fig. 6.—Cable alternator, transmitter, and perforator.

The cable upon which these preliminary experiments were conducted is known as the "Coney Island" cable, belonging to the Commercial Cable Company, and extends from New York City, U. S. A., to Canso, Nova Scotia, having a length of 880 knots.

Since the speed of signaling or the number of letters per minute which can be transmitted and received by a given set of instruments on a submarine cable depends upon the magnitude of the electromotive force as well as upon the shape of the wave, it is important to note the differences between the physical phenomena

* Abstract of a paper presented at the seventeenth general meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1900.—From the Transactions of the American Institute of Electrical Engineers.

which take place in the sine wave and battery methods. The speed is not proportional to the voltage by either method, but the increment becomes less and less as the pressure is increased, until it may be necessary to double the voltage to gain a few letters per minute. There is a practical limit to the voltage with any particular cable which it is not profitable to exceed, since the gain in speed is so slight. The limit of voltage which it is profitable to employ is not the same for the sine wave as for the battery method. To obtain the best speed with either system it should be worked at this maximum voltage point, which limit can only be determined by experiment. Before such a limit is reached, however, there are often other causes which prevent the best voltage from being employed. If a fault develops, a high potential at that point might effect the complete interruption of the cable. When the fault is discovered, it is customory to reduce the voltage to prevent entire interruption. There is at present such a fear of employing high voltage on submarine cables that a limit is set to the pressure at which cables may be operated, and this limit, for most of the cables of the world, is little more than 50 volts. Modern cables are subjected to a pressure of 5,000 volts alternating while in the cable tanks for a period often as great as half an hour. Thus the voltage at which the cable is tested is 100 times as great as that actually employed in signaling. The insulating material of an uninjured cable will withstand as high pressures as will ever be desired in signaling, but no factory test can guarantee the cable from mechanical injury after it is laid

Since the voltage is limited upon a cable, it is evident that the system which can furnish the higher speed at the same pressure has the advantage, or that system which can furnish a given working speed with the lowest voltage is safest to employ.

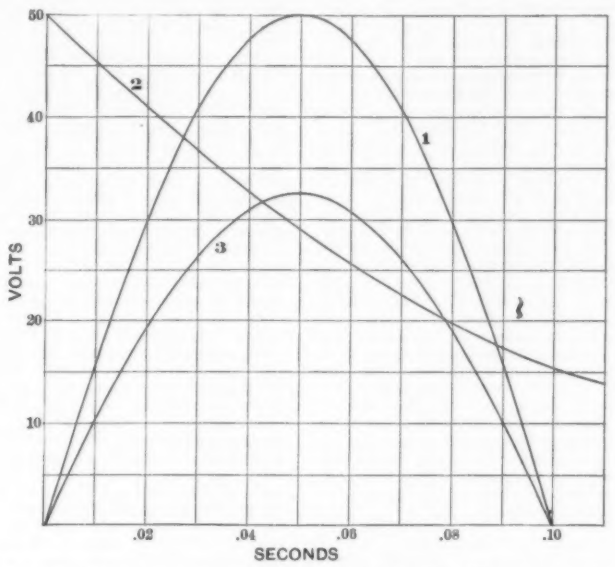


FIG. 7.—(1) sine wave and (2) battery wave having the same maximum; (3) fundamental term or effective component of battery wave 2.

The true definition of equivalent voltage from this standpoint would then be such pressures as would equally strain the insulating material of which the cable is constructed.

The breaking strain of an insulating material not only depends upon the pressure to which it is subjected, but upon the time during which that pressure is applied. It is well known that the dielectric of a condenser may break down in time under the same voltage which it has withstood for a considerable time. The maximum pressure therefore if only of brief duration should be allowed to be higher than a pressure which is continuous to cause the same breaking down strain in the dielectric. With a battery applied suddenly to a cable without condensers the whole pressure is upon the cable during the entire length of a signal, whereas with the sine wave method the maximum voltage is applied but a single instant and cannot be applied longer if desired.

If air were the insulating material of a submarine cable it is known that the breaking strain is measured by the maximum voltage to which it is subjected, and is independent of the time during which this pressure is applied. When gutta percha or rubber are the materials used for insulation this time element should be considered. The effect, however, would vary for each particular compound, and can only be determined by careful tests.

Equivalent voltages are, therefore, considered to be employed by the two systems when the same maximum potential difference between the core of the cable and the earth is attained at some time during each signal.

The fact that condensers are employed between the transmitter and the cable so modifies the pressure applied to the cable itself that the voltage and the methods of measurement are entirely different in the two systems. When a sine wave is employed, the pressure may be read directly from an electrostatic voltmeter between the end of the cable itself and the earth. Because they are sine waves the voltmeter reading multiplied by the square root of two or 1·414 gives the maximum value or top point of the voltage wave. If the maximum voltage on the cable is to be 50, then the voltmeter between the cable and earth should read $50/\sqrt{2} = 35{\cdot}4$.

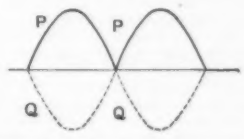
As has been pointed out above, it requires a greater voltage than this applied between the apex of the bridge and the earth to produce the required pressure upon the cable because of the drop due to the impedance of the condenser. The apex voltage, therefore, depends upon the capacity of the condenser and the frequency.

When a battery is employed, the open circuit pressure of the battery is measured. If there is no condenser, then the cable is subjected to approximately the full battery pressure, which remains continuously applied as long as the battery is connected. There is a slight fall of potential through the battery, which in ordinary practice may be neglected, since the battery resistance is small compared with the impedance of the cable. When a condenser is used and the battery is suddenly applied to the apex of the bridge, the whole battery pressure, except the small loss already referred to in the battery, is applied between the cable itself and the earth, since there is at the first instant no counter electromotive force in the condenser to reduce the cable pressure, the condenser being originally in the neutral state with no charge, and, therefore, no counter electromotive force. In time, however, the condenser acquires a charge, and with it a counter electromotive force which increases from zero at the first instant to a value which finally prevents all current flow in the cable. The pressure upon the cable, therefore, begins at the battery pressure and rapidly diminishes with time until it has practically vanished in a fraction of a second. In either case whether condensers are employed or not, the maximum pressure to which the cable itself is subjected is approximately equal to the battery voltage. The difference is that with condensers this pressure is momentary, while without them it is continuous. The phenomena with a sine wave and a battery wave depend entirely upon the manner in which the electromotive force is applied. When applied suddenly as with a battery the condenser has not had time to acquire a charge or counter-electromotive force before the maximum pressure is reached. With a sine wave beginning at zero and increasing gradually to a maximum, the condenser acquires a charge before the maximum point is attained, and, therefore, the apex pressure must exceed the cable pressure. The rule for obtaining equivalent voltage in the two methods may then be stated by the answer to the following question: "What sine wave electromotive force steadily applied to the sending end of a cable, as measured by a properly calibrated electrostatic voltmeter inserted between the sending end of the cable and earth, produces the same maximum electromotive force in each wave as the maximum electromotive force applied to the cable by an earth connected battery, either directly as in ordinary simplex working without sending condensers; or to the apex of the bridge, and, therefore, through condensers, as in duplex working?"

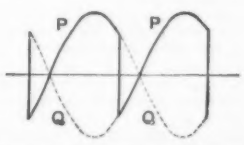
The answer is that the virtual alternating pressure or sine wave electrostatic voltmeter reading, which is 70·7 per cent. of the full battery voltage, produces the same maximum pressure in each alternation or wave as the battery. For example, a sine wave which produces an electrostatic voltmeter reading of 35·4 volts between the cable and earth is equivalent to a battery of 50 volts whether applied to the cable directly or through condensers.

It is a natural step in the development and use of the sine wave of electromotive force for cable signaling to employ ordinary alternating current apparatus, among which the closed circuit alternating current transformer occupies a conspicuous place. It was not until after a transformer had been obtained, with a view of using it in transmitting messages, that the good results obtained with transformers in England by Mr. Dearlove came to our notice. The transformer used was a commercial one, specially wound with five separate coils, designed to operate on 1,000, 500, 500, 50, and 50 volts respectively.

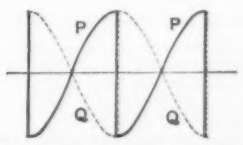
In using the transformer for signaling, the alternator



(3) Electromotive force in circuit (P) when commutator brushes are situated so as to reverse the circuit at time of zero electromotive force; that is, at the normal point of commutation for no sparking.
(4) Electromotive force in circuit (Q) under same conditions.



P. Electromotive force in circuit (P) when commutator brushes are moved one-quarter of a revolution from the normal position.
Q. Electromotive force in circuit (Q) under same conditions.



P. Electromotive force in circuit (P) when commutator brushes are moved one-eighth of a revolution from the normal point of commutation.
Q. Electromotive force in circuit (Q) under same conditions.

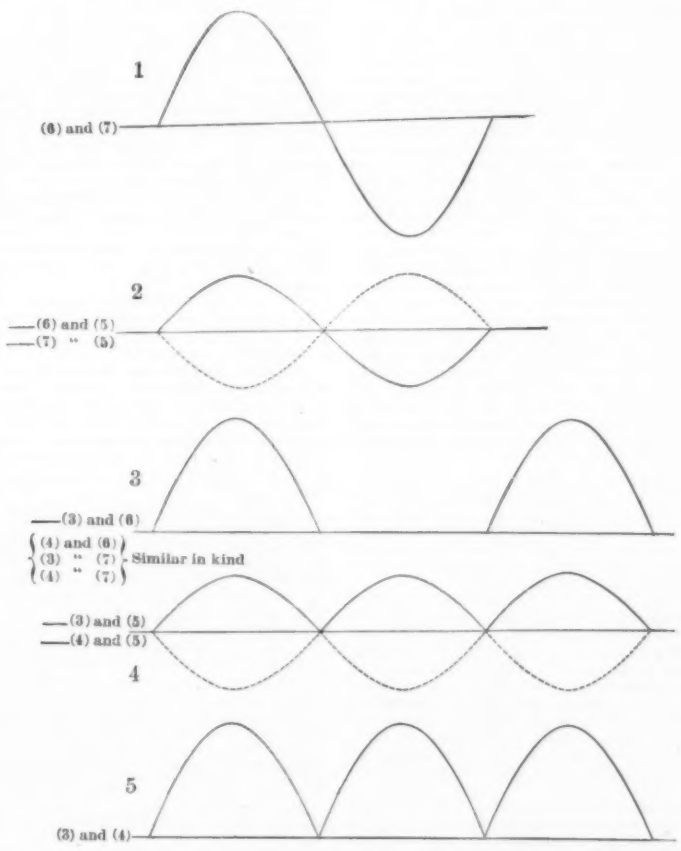


FIG. 8.—Forms of electromotive force obtained by connecting the various alternator brushes.

is connected directly to the primary, while the secondary, which may be considered as the source of the transmitting electromotive force, is connected directly between the apex of the bridge and earth. This gives a permanent low resistance connection between the cable and the earth and dispenses with any form of earthing device. The general effect of the transformer is to give a natural curb to the impulses transmitted through it, since a single positive sinus in the primary circuit produces both a negative and a positive sinus in the secondary circuit whose values depend upon the inductance and the frequency. With an adjustable inductance, the general characteristics of the received record can be changed materially and at will, so that the "s" or "h" may either rise from the zero line, descend toward it, or remain approximately horizontal.

To determine whether the magnitude of the current received through the Atlantic cable is sufficient to operate a receiving transformer, messages were sent from Canso and received in Waterville. The regular duplex arrangement was retained, and the primary of the transformer inserted where the siphon recorder ordinarily is, the condenser in series with the recorder being removed. The particular winding of the transformer then available was not suitable for obtaining the best results over the cable, but records were obtained which could be read, and the above is cited as showing that there need be no hesitation in employing transformers as far as the magnitude of the currents is concerned.

The substitution of comparatively inexpensive transformers for the condensers now required in duplex working would be an advantage from many standpoints. In the future development of cable telegraphy, both the transformer and the condenser will probably play an important part.

The real test of cable apparatus is its efficiency for continuous work in the hands of average cable operators, and in the development of the details of the transmitter its use in actual traffic on the Atlantic cable for several days at a time has been of great value.

One of the radical features of the transmitter shown is the employment of small steel brushes, making contact through the perforations in the tape with a platinum cylinder having a corrugated surface. The present automatic transmitters of the Wheatstone type, make the electrical contacts at a point away from the transmitting tape by means of a system of levers. In using the alternating current always interrupted at the zero point there is not the same objection to the use of brushes due to sparking which is the case when a direct current is suddenly broken at a high voltage. Any system of levers is impossible for very high speed telegraphy, and the elements of a transmitter could hardly be more simple and direct acting than making contact through the tape with some form of brushes. It is evident that either form of transmitter may be used with the cable alternator, but the brush form as now perfected is preferred.

The sine wave transmitter removes the necessity of any form of battery power for a cable station. The same armature furnishes the power for hand transmission as well as automatic, and the same convenience in switching from one to the other is maintained as at present. The present tendency in telegraphic engineering is to remove all forms of primary batteries as a source of power, and the sine wave alternator combines this advantage with the most efficient form of wave for signaling.

[Continued from Supplement, No. 1282, page 20558.]

AMERICAN ENGINEERING COMPETITION.

III.—THE HEAVY IRON AND STEEL TRADE.

[This series of articles on American Industries was written by an expert of The London Times, who made an extensive trip through this country in order to prepare the articles, the first of the series being published in the Supplement of July 21.]

The Americans have determined to keep their home market for iron and steel, as for other things, in their own hands, and for that purpose have imposed the prohibitive duty of $4 (16s. 6d.) a ton on foreign pig iron, $7.84 (£1 12s. 3d.) on steel rails, and $13.44 on steel ship plates. These duties alone are sufficient to explain the falling off in our exports of iron and steel to America, although they can hardly be made to account fully for the fact that we, who not long ago considered ourselves the natural producers of iron and steel for the rest of the world, should have imported into Great Britain £6,000,000 worth more iron and steel during 1898 than the Americans imported. On further reference to the records of the trade between the two countries for that year it will be found that we sent to the United States £1,744,535 worth of goods that might be included under the heading "iron and steel manufactured or unmanufactured." On the other hand, the Americans sent to us £3,723,910 worth of goods of the same description.

So much for competition in our home market; but it will be interesting to glance at the conditions which prevail in those foreign countries that have been among our best customers in the past. Before doing this, however, I will remind the reader, even at the risk of repetition, that any competition we may have experienced up to now is as nothing compared to that which will come with the slackening of home demand in America. The very large additions to factories and plants in that country during the last year or two have been caused by the phenomenal growth of its home demand. When once that slackens all these powerful engines of industrial warfare will be turned on to markets formerly our own, and will be directed by a people more intelligent, and incomparably more energetic, than any we have yet had to meet during the whole period of our industrial existence. The records of exports from the United Kingdom and United States respectively show that the competition in pig iron is not very strong yet; indeed, it is remarkable that there should be any competition at all for an article worth, at the period under review, not much more than £3 a ton, and which has to be carried three to four thousand miles. The conditions governing the shipment of pig iron are, however, altogether unusual, and in the future may become of importance. That shipped from the United States is almost entirely from the Southern district, of which Birmingham, Alabama, is the principal center. This town is some distance from any port, the rates averaging about $1 per ton to Mobile, on the Gulf of Mexico, 270 miles distant, or to Pensacola, 258 miles; while to New Orleans it is $1.65, to Brunswick and Savannah, $1.75, or to Norfolk, in Virginia, $2.25 the latter being the nearest port to the European market. The Southern export trade is, as was stated two years ago by Mr. Archibald P. Head, "fitful, and cannot be said to have found its true level yet."

The product of this district has hitherto been foundry and forge iron, but at the end of November last practically the first cast of steel was made. What this may develop into it is difficult to say, but, if the South can take the same place in steel that it has in pig iron, then there will be still stronger competition for existing interests, and the steelmakers of the United Kingdom will not escape.

It is not only from Alabama, however, that we may expect to find pig iron in markets we have hitherto held. For instance, the Tonawanda Iron and Steel Company have extensive works at Buffalo, where large quantities of foundry pig iron are turned out for the general market. There are two furnaces, and they average about 425 tons a day, which is a good deal above the British rate of product for foundry iron. The arrangements here are very complete, both for the handling of material and for the manufacture of iron. Ore is brought from the Lake Superior mines right to the Niagara River, upon which the works are situated, the average arrival during the season being one ship a day. Here, as elsewhere, home demand at present monopolizes supply; but a good deal of Tonawanda iron has been shipped abroad, notably to Australia, by Messrs. Rogers, Brown & Co., of New York, who control the product. Very cheap water carriage is secured from Buffalo to New York by the Erie Canal and Hudson River, the rate being about 3s. per ton, as compared to 9s. 6d. by rail. In this way we have the noteworthy fact of ore being brought from the head of Lake Superior, traveling not very far from two thousand miles without land carriage before it gets to the ocean port, having been converted into pig iron on the way by the Tonawanda furnaces, and being then carried half round the world to compete with our own product in one of our own colonies. Those interested in the American venture are sanguine that a large part of the iron trade, not only of Australia, but of many other parts of the world, can be secured in this way, and they are confident that in normal times American iron will beat the British product in price. In support of this they point out that, as a rule, low freight can be secured from American ports owing to ships going out in ballast. The rate might be as low as 10s. per ton, though the trade would stand a rate of 16s. per ton.

It would be interesting to give an account of the Tonawanda works, describing the various appliances for handling material, etc. I propose, however, to deal with this branch of the subject in connection with the still more important iron and steel works of the Pittsburg district, and do not wish to go over the same ground twice. It must suffice to say, therefore, that the plant is of the best description; in fact, the works are more like a good modern steel plant than an establishment intended simply for the production of foundry pig.

It is not anticipated by Americans generally that a large and constant foreign trade will be done in pig iron, but rather in iron and steel in its more manufactured form. Still, the moral for us of the Tonawanda furnaces is none the less true. They teach that it is only by liberal if judicious expenditure of capital in maintaining plant in most efficient condition, and by studying the special needs of purchasers, that we can keep our hold on any trade. In spite of distance and in spite of ancient prestige we shall be beaten unless some of us wake up to the fact that obsolete appliances, old, slow methods, and the old carelessness of customers' needs must give place to something more businesslike and more intelligent.

Our exports of pig and puddled iron were actually less in 1898 than they were 14 years previously, in 1884, the latter year representing almost high-water mark in this field. The fact, however, still remains true that the British exports of pig iron far exceed those of the United States. In 1898 we sent abroad in all £2,739,093 worth of pig iron to all countries, including British possessions, while the United States only exported pig iron to the value of £568,747. It may be added for the sake of comparison that Germany in 1897 exported £249,500 worth of pig iron, but this was rather a bad year, the maximum figure of £402,450 being reached in 1894.

It will be seen that we have still a long lead in the somewhat lean export trade of pig iron. It would be a more satisfactory business were it not for the thought that so much of this iron goes abroad simply to be made into machinery to compete with our own products of the same description. Still, we should be glad to do any trade that brings a profit.

Turning from raw iron to the manufactures thereof one finds that our exports of iron—bar, angle, bolt and rod—have fallen off nearly £100,000,000 since 1884, or almost 100 per cent., a fact to be attributed to some extent to the increase in the use of steel. Reference to American figures, however, shows that the exports of bar iron from the United States have steadily increased during the last ten years, and in 1898 were between three and four hundred per cent. more than in 1889. The totals cannot be compared with the corresponding English figures owing to the difference in classification.

During the last ten years our export of rails has fallen off. In 1889 we supplied to other countries £3,500,000 worth, although this was a decline from the early eighties, when our total of rail exports rose to over £5,000,000 worth; and this again from the figures of the early seventies, when we sent abroad yearly £10,000,000 worth of "railroad iron," of which probably £8,000,000 was represented by rails, for the different items were not separated in the statistical account of those early days. From these heroic figures of our prime we dropped in the year 1898 to somewhat over £2,000,000 worth of rails (£2,173,665), or just upon £3,000,000 worth for railroad iron of all sorts. This is over £1,000,000 less than the years 1866 to 1868, over £4,000,000 less than the year 1869, over £5,000,000 less than 1870 and 1871, and over £7,000,000 less than the average for 1872 to 1874. Indeed, the only time the 1898 total for railroad iron was not exceeded during the period 1866–1891 was in 1879, and then the difference was but small. In 1892 a period of extreme depression arose. For long past the splendid totals of the seventies have remained unapproached.

While British exports of rails have been declining those of the United States have been advancing from modest beginnings, as became a young industry, until now they have quite a respectable importance. Ten years ago the shipments of American rails to foreign countries were one-seventy-fourth of our own exports in value. In 1898 they had advanced to about one-half. This gain upon us has been chiefly within the last four years, during which period the value of American rail exports has increased sixteen fold. But, though the American makers have been gradually wresting some of our markets from us, we still hold a lead in the trade.

What British makers should now ask themselves is, "How long is this lead likely to remain?" For it will be no good putting the question when the trade has gone. Having already given figures as to exports, I will quote those relating to total production. In 1898 there were produced in all 772,035 tons of rails in the United Kingdom, the American mills in the corresponding year turning out 1,981,211 tons, or over two and a half times as much. Since 1898, even during the last few months, the facilities for production in America have been very largely increased, and yet makers are at their wits' end to execute orders for the home trade. The slackening of this demand will bring the crucial test between the rail makers of the two countries, and we shall see which is the fittest to survive. At the present moment we are going on very merrily, with trade enough for all at high prices.

In another important branch of the heavy manufactured iron trade—namely, sheets and plates—we do not appear to be going back so much in regard to exports, though our best years are of the past and do not seem likely to return. Taking together all sheets and plates, including galvanized plates and terne plates, and adding to these hoop iron, so as to harmonize classifications, we have a total of exports of about six and a half millions sterling for 1898. This does not compare favorably with the totals of about 10,000,000 of the late eighties and early nineties; but the bulk of these was made up by tinplates, of which we still export large quantities, though there was a big drop in the latter commodities in 1892, due to the fiscal arrangements of the Americans, over which we have no control. It should be noted that, while in 1889 we sent over £6,000,000 worth of "iron, wrought and unwrought," to the United States, in 1898 we sent only £1,250,000 worth. On the other hand, we took from them in 1889 about £500,000 worth of iron and steel—of which a large part was due to sewing machines; in 1898 the figure had grown to about £3,750,000, including £2,000,000 worth of machinery.

Whatever may be the explanation of these figures, or whatever consolation may be drawn by economists from this swelling of our imports, the fact remains that our exports of iron and steel to America have fallen, during ten years, from a large to an extremely small total, while on the other hand the United States are not only successfully competing with us in foreign markets but are, to some extent, beating us at home. The ordinary and inevitable fluctuations in trade—fluctuations which may not coincide in two countries, and which will, therefore, cause prices to be higher in one than in the other at a given time—will naturally create a rise and fall in the exports and imports of any two countries where the facilities for production are at all equally balanced. An example of this was afforded by the hanging fire for a short time in America of the last great trade revival, so that we found United States goods coming into our markets simply because American manufacturers were glad to sell at almost any price, and not because commodities were more cheaply made than we could make them. Such occurrences we might regard with equanimity, feeling confident that the see-saw of trade would one day equalize matters. The gain of the Americans has been, however, fairly constant.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Customs Regulations in Canada.—Commercial Agent Johnson, of Stanbridge, under date of June 9, 1900, reports that the Canadian government has adopted similar regulations to those of the United States, requiring triplicate invoices, one to be filed at the port of entry, one with the shipper, and the remaining one to be forwarded to the Department of Customs at Ottawa.

On June 15, Mr. Johnson adds that the department is putting into force the following new regulations, which are of particular interest to importers:

The invoice produced for entry at the custom house, in respect of goods purchased by an importer, shall be an invoice from the person, firm or corporation selling the goods to such importer. The invoice shall be properly certified, and shall faithfully represent the transaction between the seller of the goods and the importer in respect of such goods, and shall truly exhibit the actual price paid and to be paid for the goods by the importer making entry thereof, including the cost of coverings of any kind and all charges and expenses incident to placing the goods in condition, packed ready for shipment direct to Canada. Goods bona fide exported to Canada from any country, but passing in transit through another country, shall be valued for duty as if they were imported directly from such first-mentioned country, subject to the following conditions, namely:

(*a*) The bill of lading for the transportation of the goods to Canada shall show the ultimate destination of the goods from the place of original shipment to be a port in Canada, without any contingency of diversion, and the goods shall not be entered for consumption or for warehouse, or remain unclaimed, or remain for any purpose other than their transshipment or transit in any intermediate country.

(*b*) The said bill of lading for the transportation of the goods from the port of original shipment to Canada, or a certified copy or copies thereof, and such further evidence as the collector may require to establish the direct exportation of the goods from the place of original shipment to a port in Canada, as hereinbefore provided, together with a proper invoice of the goods, shall be produced by the importer to the

collector of customs at the port of entry; provided that a customs certificate showing the transshipment of the goods in a British or foreign port, without entry thereat, for consumption or for warehouse, or for any other purpose than their transportation in transitu to the port of destination in Canada, may be required by the said collector as further evidence, in any case where he deems it necessary, in addition to the bill of lading; provided also that any original bill of lading when so produced to the collector and marked with the customs stamp may be returned if a "transitu statement" (in a form approved by the Minister of Customs) containing the material facts set forth in the bill of lading respecting the consignment, including package marks and freight charges, be filed with the collector and be by him compared with the particulars in the original bill of lading.

(c) Goods subject to an ad valorem duty not imported in conformity with these regulations shall be valued and appraised at their fair market value, as sold for home consumption in the principal markets of the last country whence the goods were transported into Canada, at the time when the same were exported from such country.

American Trade in Scotland.—In trade circles in the east of Scotland there is evidence of the increasing activity of American manufacturers in the foreign market. More and more they are getting directly in touch with the trade, with the buying public, either personally or by immediate and responsible representatives, and are showing the same enterprise in working up business that they apply so successfully in the home market. This plan of acquiring foreign trade was pursued rather timidly by our manufacturers previous to 1898, at least in this part of Great Britain. During the past two years it has developed rapidly in some lines of trade, and the results are seen in the greatly increased sales of nearly all kinds of machinery, hardware, woodenware, furniture, rubber goods, leather goods and a variety of other products.

While it is true of most American-made articles that when seen under favorable conditions they recommend themselves, it is nevertheless true that, as a rule, in Scotland an article cannot be depended upon to sell itself; it must be presented in the right way, by the right people, and to the right people. Even American printing presses and laundry machinery, which have no equals anywhere, have only gained a place abroad through the persistent efforts of men thoroughly familiar with them and able to demonstrate their merits. In this country, and perhaps in every other, not only an indifferent article, but a first-class article as well, requires "pushing" in order to give it a progressive impetus. An American inventor and maker of an important apparatus used in connection with steam engines in several branches of manufacture secured only a moderately profitable trade in Scotland so long as he left the matter wholly in the hands of agents. A few months ago he came over here; a little investigation disclosed the extent of the market for his machine; he joined his agents in a campaign of "push," with a highly satisfactory result, which, he informed me, would be of great value to him for years to come, even if he should pay no further personal attention to this market. The application abroad of energetic American methods is to be noticed here at the present time in various lines of trade. The latest instance is that of a prominent American company manufacturing agricultural machinery, which has sent one of its most expert salesmen to Scotland to work with its local agents in a farm-to-farm canvass of the country.

This keen spirit manifested by the captains of American industry in promoting foreign trade can hardly fail to swell the tide of our exports of manufactures.—Rufus Fleming, Consul at Edinburgh.

United States Coal for Brazil.—Minister Bryan writes from Petropolis, June 1, 1900, that in response to a note to the Brazilian Foreign Office, requesting information as to a contract for furnishing pit coal to the Central Railroad of Brazil, he has been informed that there is no doubt that United States coal will be used if it is of superior quality to coal already presented for trial. Copy of the last contract, with specifications, was sent Mr. Bryan, and will be transmitted by him and printed in advance sheets as soon as received. The opportunity seemed so favorable to the minister that he sent notice in advance, without waiting to translate the specifications.

Preventing Incrustation in Boilers.—Consul Hughes sends the following from Coburg, May 17, 1900:

Mr. A. Reis, of Antwerp, has patented the following method for preventing incrustation in boilers: A mixture of sugar, tannin extract, silicate of potash or soda, and boric acid is added to the boiling water to keep the salts in solution; when the water attains a density of about 15 to 25 Bé, the boiler is "blown off." The working periods range from a fortnight to three months, according to the quality of water in use. Glycerine and alkaline sulphates are sometimes used in the mixture.

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No. 781. July 16.—Special Taxation of Department Stores in Germany—Changing Conditions in the German Iron and Coal Markets—*Musical Instruments in the Philippines.

No. 782. July 17.—Electrical Tramways in Barcelona—Change in Turkish Tariff—*German Stoneware Factory—Imports into Madagascar.

No. 783. July 18.—Mineral Resources of Haiti: Railways—*American Clover Seed—*Foreign Shares in Japanese Railways—*Guatemalan Cattle Exports—*Property Tax in Madagascar.

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No. 785. July 20.—American Products in Siberia—*New German Process of Welding Pipes—Public Works in Paraguay—Agricultural Exports from Uruguay—*Chemical Foods in Germany.

No. 786. July 21.—Hints to Nail Exporters—Export of Argentine Wheat—Tool Trust in Germany—United States Vessels at Vancouver—Pulp Mill in British Columbia—Trade of Smyrna.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Dry Depilitary.—

Barium sulphide	10 parts.
Zinc oxide	5 "
Wheat starch	5 "

Rub up into a very fine powder.

Before use, grind the powder with water into a thick paste and allow same to act for 10 minutes.—Apotheker Zeitung.

Increasing the Solubility of Dextrin.—A process of producing a dextrin readily soluble in cold water has been patented in Germany. It consists in mixing dextrin with a lime salt readily soluble in water, calcium nitrate having been found to be especially suitable for this purpose. A mixture of 800 grammes dextrin and 200 grammes calcium nitrate, with 1 liter of water poured over, furnishes a mass of great adhesive power. It may also be used as a binder for water colors.—Neueste Erfindungen und Erfahrungen.

Durable Enamel Paint.—A varnish paint, which does not turn liquid even in high degrees of heat, nor crack off, is obtained by a cold solution of native asphalt in crude benzol, crude petroleum, and benzine. As ratio, Gawalowski recommends: Asphaltum, 10 parts; crude benzol, 30 parts; crude petroleum, 15 parts; and benzine, 60 parts. The coating dries quickly, the rapidity increasing with the amount of benzine used. Metallic powder (bronze) may also be stirred in, so that the varnish also serves for decorative purposes.—Neueste Erfindungen und Erfahrungen.

Graphite Paste Stove Polish.—

Ceresin	120 grammes.
Japanese vegetable wax	100 "
Turpentine oil	1,000 "
Fine lamp black	120 "
Graphite	100 "

Unite ceresin and wax by melting, add to the half cooled, liquid mass the lamp black and graphite ground in the oil of turpentine and stir until completely cool.—Farben Zeitung.

Brilliant Bacq.—This product, destined for polishing carriages and furniture, is composed of the following ingredients:

Linseed oil	272 grammes.
Petroleum	380 "
Camphor	60 "
Wax	120 "
Essence of turpentine	120 "
Whiting	24 "
Volatile alkali	24 "
Total	1,000 grammes.

—La Revue des Produits.

Action of Salt Water Upon Metallic Alloys.—The German admiralty has made exhaustive tests regarding the action of sea water upon alloys of metals. Strips of alloys were employed for this purpose which were exposed to the action of the air and the sea water for a period of up to 2½ years. The metals examined were chiefly copper alloys with various percentage of zinc, pure zinc bronze, pure iron bronze, and pure aluminium bronze.

With relation to the tests on the destruction in the air, it was found that aluminium bronze during the space of 2 years did not undergo any noticeable changes, but that the metals containing a larger amount of zinc were quickly going to ruin.

In water, the alloys with iron and tin, as well as aluminium bronze, suffered but little destruction. Investigation after 2 to 2¼ years showed no perceptible change, neither in weight nor in strength. Iron bronze with zinc bronze, however, were strongly attacked, one object tested losing two-thirds of its strength and four-fifths its original length. The material was destroyed in such a manner that the zinc became detached. A plate of wrought iron bronze was placed in the sea water together with a cast one of the same material and lost about 50 per cent. of its strength in 2 years.

The admiralty assumes that the decay of the different alloys is dependent upon their electric behavior. As a proof, therefore, the fact is cited that aluminium bronze, whose resistance to salt water is sufficiently known, was quickly destroyed as soon as it was placed in the sea water together with electro-negative metals, while it remains intact when the other metal is an electro-positive one. Consequently all alloys which are to resist decay by salt water should be composed of such metals which approach each other in their electric behavior.—Deutsch Mechaniker Zeitung.

High Temperatures with Aluminium.—The Neue Freie Presse describes a new process for the generation of high temperatures by aluminium, on which Dr. Hans Goldschmidt, of Essen, delivered a lecture before the chief meeting of chemists at Hanover.

The process is based upon the invention of Dr. Goldschmidt to obtain a fire-liquid mass of especially high temperature by means of a mixture of metallic oxides and aluminium called "thermite" in a simple and quick manner. This process is pre-eminently employed for the production of chemically pure metals, free from carbon—chromium, manganese, vanadium, ferro-boron, etc.—and is of great importance for iron alloys. Secondly, it is employed for welding pipes and tracks, without a workshop, at any place and any time with a simple crucible at considerably less cost. The welding is excellent, and withstands 400 atmospheres pressure in the pipe. The pipes burst rather in a longitudinal direction than at the place where they are welded. Fire-liquid thermite poured on a block of iron melts it like hot water does a pile of snow. Burglar and fire-proof safes no longer offer any resistance. Armor plates are pierced. In Essen and Brunswick the street car tracks are welded by this process. The welding is carried out by filling a crucible with a few spoonfuls of thermite, throwing on a little igniting mixture and lighting with a storm match. It is perfectly devoid of danger. Dr. Goldschmidt demonstrated the process on the wooden experiment table of the technical high school at Hanover. Temperatures of more than 3,000° C. require operations of two to three minutes. The operation takes place so quickly that the crucible remains cold and can be taken up with the hand. The fire-liquid mass in the crucible consists of molten iron; it is alumino-thermal iron. On top floats corundum, i. e., aluminium oxide. With this process a new branch of science has arisen, viz., "aluminothermy."

SELECTED FORMULÆ.

Remedies for Insect Bites.—

1. Carbolic acid	15	grains.
Glycerin	2	drachms.
Rose water	4	ounces.
2. Salicylic acid	15	grains.
Collodion	2½	drachms.
Spirit of ammonia	5½	"
3. Fld. ext. rhus toxicodendron	1	drachm.
Water	8	ounces.
4. Ipecac, in powder	1	drachm.
Alcohol	1	ounce.
Ether	1	"
5. Betanaphthol	30	grains.
Camphor	30	"
Lanolin cold cream	1	ounce.
6. Sodium bicarbonate	2	drachms.
Sodium chloride	2	"
Water	4	ounces.
7. Olive oil	1	ounce.
Water of ammonia	1	"
Oil of turpentine	½	drachm.
Tincture of opium	½	"
8. Menthol	8	grains.
Alcohol	6	drachms.
Dissolve and add stronger ammonia water	2	drachms.

For application to insect bites, touch the part with a drop of the fluid on the point of a toothpick.

9. Cocaine hydrochlor	10	grains.
Glycerin	15	minims.
Alcohol	2	drachms.
Rose water, to make	2	ounces.

Blue Stencil Ink.—The basis of the stencil inks commonly used varies to some extent, some preferring a mixture of pigments with oils, and others a watery shellac basis, and we give alternate formulas:

THE BASIS.

1. Shellac	2	ounces.
Borax	1½	"
Water	10	"

Boil together until 10 ounces of solution is obtained.

THE COLORING.

Prussian blue	1	ounce.
China clay	½	"
Powdered acacia	½	"

Mix thoroughly and gradually incorporate the shellac solution.

2. Prussian blue	2	ounces.
Lamp black	1	"
Gum Arabic	3	"
Glycerin, sufficient.		

Triturate together the dry powders and then make into a suitable paste with glycerin.

3. China clay	1	part.
Prussian blue	2	"
Boiled linseed oil, sufficient.		

Mix intimately the china clay with the Prussian blue and make a paste of suitable consistency with the boiled linseed oil.

4. Shellac	2	ounces.
Borax	2	"
Water	25	"
Powdered acacia	2	"
Ultramarine sufficient.		

Boil the borax and shellac in water until they are dissolved, and, when cool, add the powdered acacia, stirring until it is dissolved. Add water to complete 25 fluid ounces and add sufficient ultramarine to make an ink of the right consistency. When it is to be used with a stencil, it must be made thicker than when it is applied with a brush.—American Druggist.

Putz Pomades.—The Journal der Goldschmiedekunste gives the following formulæ for polishing pomades:

1. Anhydrous sodium carbonate	5	parts.
Tallow soap	20	"
Levigated emery	100	"
Water	100	"

Mix, put on the water-bath and heat, under constant agitation, until a smooth homogeneous paste has been obtained.

2. Jewelers' rouge	1	part.
Petrolatum	1	"
Oil of mirbane, q. s. to perfume.		

Mix intimately.

3. Oil of turpentine	1	part.
Levigated emery, finest	1	"
Jewelers' rouge	2	"
Petrolatum	2	"
Oil of mirbane, q. s.		

Rub up together to a homogeneous pomade.

4. Emery flour, finest levigated	50	parts.
Jewelers' rouge, finest	50	"
Mutton suet	40	"
Oleic acid, crude	40	"
Perfume, q. s.		

Melt the suet and oleic acid together in the water-bath, and when thoroughly mixed remove from the fire. When cooled down, but still soft, add the powders, and rub up until they are evenly distributed throughout the mass. The perfume may be added at the same time as the powders.

5. Stearin	8-9	parts.
Mutton suet	32-38	"
Neatsfoot oil	2-2·5	"
Jewelers' rouge, finest levigated	20	"
Levigated calcium carbonate	40-60	"

Melt the suet, stearin and oil together, and proceed as in No. 4.

6. Quartz sand, powdered and levigated	20	parts.
Jewelers' rouge, finest levigated	30	"
Vaselin	50	"

Mix. Instead of quartz sand, levigated infusorial earth may be used.—National Druggist.

THE STRANGE FEATS OF A CIRCUS HORSE.

ALTHOUGH circus horsemanship has not developed of late years, it must be confessed that in the training of horses very considerable progress has been made—progress which speaks well both for the ability of the modern trainer and for the intelligence of the horse.

THE FEATS OF A TRAINED HORSE.

What skill and patience can do in teaching a horse to perform feats which are hardly to be expected of an animal, the habitues of the Circus Schumann in Berlin recently had an opportunity of witnessing.

The horse in question, named "Good Night" by his owner, first makes his appearance dressed in clothes which resemble as closely as possible the apparel of a Berlin dandy. His rear legs, says The Illustrirte Zeitung, are covered with trousers of a pattern more fantastic than even a German "gigerl" would dare to wear; his forelegs, shoulder and body are clad in a blue coat of fashionable cut; his neck is surrounded by a linen collar, which, although of enormous dimensions, fits rather well; and his front feet are incased in cuffs of corresponding size. As if conscious of the fact that his clothes demand a more dignified behavior on his part than is expected of four-footed animals, "Good Night" stalks into the arena on his hind legs, imitating the gait of a human being.

At a command from his master, the horse proceeds to undress himself. With his teeth he seizes the lapel of his coat, releasing a cord, whereupon the whole garment parts and falls to the ground. The horse carefully picks up the halves of his coat and lays them upon a chair. In like manner he removes his trousers, leaving only the shoes to be taken off. For a human being the removal of the shoes is no very difficult matter, but for a horse it is exceedingly cumbersome. "Good Night," however, takes off his shoes with most wonderful skill. Carefully sitting down upon a bench or stool, he bends down, grasps his shoes with his teeth, and in an instant pulls them off.

After having thus undressed himself, "Good Night" shows how he goes to bed. He gallops out of the ring, but soon returns, pushing before him a heavy bedstead with bedding. Carefully he arranges the sheets, blankets and pillows, lights a candle standing upon a nearby table, and seats himself on the edge of his bed.

Before sleeping, he glances at a newspaper, which an attendant holds out for his inspection, and then blows out the light. He then lies down, his head upon the pillow, and pulls the silk cover over his body up to his very ears.

TIEN-TSIN.

WE give herewith, from L'Illustration, a few views taken in Tien-Tsin, the commercial metropolis of Northern China, upon which the eyes of the world are now concentrated. This city, which is the port of Peking, eighty miles distant by road, is situated upon the river Pei-Ho. It is a very important and busy city, with a population three times greater than that of the capital. Everything from the south has to pass through it. Like all Chinese towns, it is dirty and provided with narrow streets. To the south of the city are the foreign concessions, which have good streets and fine houses. As may be seen in one of the engravings, the French concession contains scarcely anything but commercial houses.

The river divides the town, and the banks are lined with junks, three and four deep, unloading grain and transshipping it into smaller junks for Peking. All the grain from the junks and steamers is transshipped at Tien-Tsin.

The railway station is upon the left bank of the river, which is crossed by a bridge of boats.

Li Hung Chang, the Viceroy of Tchi-li, has his yamen at Tien-Tsin, and spends more of his time there than at Pao-ting-fu, the capital of his province.

[Continued from SUPPLEMENT, No. 1282, page 20553.]

SOME TWENTIETH CENTURY PROBLEMS.*

ONE of the most serious tasks of the investigator of the twentieth century will be the utilization of the knowledge resulting from the work of his predecessors in the field which he may select for his own activity. The rapid increase in specialization compels him to begin his own productive studies at an advanced point, while the mass of material and the array of facts over and through which he must clamber before reaching his own starting point constitutes a growing handicap against the beginner and likely often to discourage him and not infrequently to make him a loser from the start in the race for recognition and fame, but in his favor after he shall once have left it to his followers. Very probably much that he has learned at the start will have to be unlearned later, and no doubt might better not have been learned at all, for it is an unpleasant fact that little progress in any direction is made without the aid and embodiment of theories and hypotheses, many of which of necessity are tentative and sooner or later prove to be wrong, and that few wrong hypotheses fail to leave a long persistent trail of erroneous reasoning and even of observation so badly warped as to be absolutely misleading; but aside from what is faulty, there is being brought together daily an overwhelming mass of information of the greatest use, so that everything must be tested step by step as any piece of investigation proceeds, and the faulty detected and rejected, while the trustworthy is built into foundation upon which the author's own conclusions are to rest.

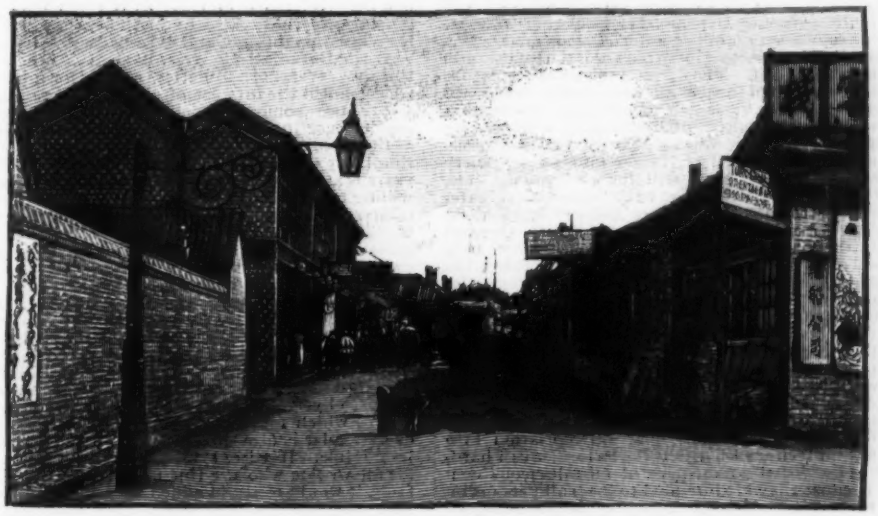
No doubt after assimilating the principal knowledge of the past, every original and really productive worker would feel a sense of relief if he could wipe out the records of this knowledge. Their existence virtually compels him to burden his own discussion of the subject with an analysis, commendatory or critical, of all that has been said of it by his predecessors--failing in which, he leaves to those who follow him the conclusion either that he has not considered the facts and deductions of earlier students, or that none exist. The presumptive value of his own work must of necessity be greatly weakened if the first opinion is held, and in the other event he is likely to seem to pose as a leader, when to the discriminating eye he is merely a follower.

No small part of the difficulty of reaching the point where one's own additions to science begin comes from the fact that the work of those who have gone before him is commonly fragmentary and disjointed. It is a first principle in research that no accurately observed fact is valueless, but its value lies chiefly in its comparability with other facts. As a rule, thought or observation on any subject stimulates the further elaboration of that subject, by drawing attention to minutiæ which any observant person may then note, though he might not have thought of connecting them himself. Science has been both advanced and retarded by the observation and record of isolated facts--advanced when observation has been followed by further study and the knitting to it of other pertinent observations, or when it has proposed a new line of study awaiting a mind great enough to grasp it, but retarded when straws have merely been added to the burden carried by the world of learning.

The botany of antiquity and of the Middle Ages was chiefly a disjointed discussion of plants, largely with reference to their uses, and not a little mixed with mythology and the fables of travelers, whose talents in straws which points to a still greater accumulation of minutiæ during the century we are so soon to enter on shows with equal probability that its passage is to be marked by a co-ordination of isolated observations and discoveries far greater than the world has ever before witnessed.

To this very desirable end we of the present day may contribute to no small degree. Our discoveries, as has been said already, are at once the handicap and the foundation stones of the men who are to take our places. The manner in which we leave the records of what we have done decides in large part the preponderance of its utility over its obstructiveness, and in many cases may even determine whether it might not better have been left undone. It is easy to justify ourselves to a certain extent when we do not do the right thing, by pleading that we did not know what the right thing was, because we interested ourselves only in a limited part of what ought to have been handled as a whole, and that posterity ought to be grateful for the substance of our contributions without being too critical as to their form and accessibility; but we are not likely to go far wrong if we assume that few of us who contribute isolated and disjointed facts and observations will ever be called blessed by coming generations in more than an undertone, that appellation being reserved for those who have builded from as well as hewn out their material, and for those who, even without directly contributing to observed facts, have justly valued the facts ascertained by others and have grouped and shaped and utilized them.

If it could be done within the time that I have proposed to occupy, I should like to consider in detail the entire matter of publication, which is in need of much more thought and concerted action than has yet been bestowed upon it. I fear that the amount of time and thought devoted to the publication of the results of a given piece of research work is often disproportionately small, the fact that they are published at all apparently serving the author's purpose without much regard to the manner in which they are brought out. Publication facilities at one time were few and not

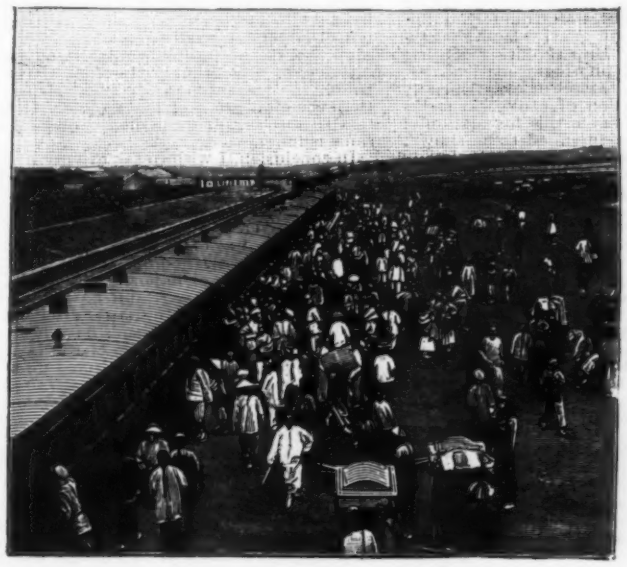


A STREET OF THE FRENCH CONCESSION AT TIEN-TSIN.

our time would have proved invaluable to the daily press. Without disparagement to the great men who went before him, Linnæus may be said to have been the first naturalist whose mind grasped numberless details with sufficient precision to really systematize them, just as in our own century Darwin stands far out from his fellows in the same respect, the power to handle and co-ordinate isolated facts which all his work shows, being particularly evident in the treatment of the great mass of heterogeneous matter on which were based his generalizations as to the variations of animals and plants under domestication.

Ours has been a century of accumulation and of utilization. It would be unjust to ourselves and our immediate predecessors to say that great laws have not been reasoned out from observed facts in larger measure even than ever before, notwithstanding the advanced point at which science stood when the century opened. It would be also in obvious conflict with the truth to say that the world of manufactures and of commerce has not been most apt to seize upon and employ the more salient discoveries of science, often in a manner not dreamed of by the discoverers; but it may still be said that the century just closing, great as have been its advances, has been a century of accumulation beyond assimilation, a period of roughing out and of laying away lumber far in excess of its employment as joists and sills and boards in the great structure of human progress.

If the evidence of the times may be trusted, the next century is to be marked by a still greater productive activity. Specialization and the attendant division of labor can have no result more logical than this. Though it may suit our convenience to speak of centuries, we know the pure artificiality of such divisions of time, and although still in the nineteenth century, we may with all propriety count ourselves of the twentieth and project the activities and tendencies of to-day into the morrow; but the same drift of the readily obtained, but to-day the trouble is rather that they are so numerous and so generally available that even matter unworthy of publication can easily be brought out, and that the authors of meritorious articles are tempted not to look far before publishing their work, but to drop it hit or miss into the nearest press, without correlation with other comparable matter or even with the articles to which it stands in juxtaposition, and with too little thought of the convenience of those who are to use it. It sometimes happens, too, that in their zeal they issue simultaneously or otherwise copies of their manuscript to several societies or journals, so that the original place of publication of the



ARRIVAL OF A TRAIN AT TIEN-TSIN.

RAILWAY STATION OF TIEN-TSIN.

* Address of Vice-President William Trelease, Chairman of Section G (Botany) of the American Association for the Advancement of Science, given at the New York meeting.—From Science.

article is now and then rendered very questionable. I should not wish to seem captious in making these statements, for nothing is further from my purpose than destructive criticism; but in view of the growing amount and complexity of scientific publication, I believe that the real needs of the users of botanical literature demand more careful consideration than they have heretofore received, and that this consideration will easily lead to a number of reforms which are perfectly within the power of both author and publisher.

Reference has been made already to the fact that a majority of periodicals are of very mixed contents. So far as societies are concerned, the greater number of these bodies have originated primarily for the development of local interests, and of necessity these interests have been varied. For their own direct purposes, the heterogeneity referred to works very little harm, and for the bibliographer it is the less troublesome because the very condensation of the miscellaneous matter in a local publication places a large part of it where it would naturally be sought. The direct purpose of the publication provisions of nearly all such bodies being not only to secure the permanent recording of observation but to furnish the means of building up a library by way of exchange, it is probable that the partly undesirable mixed contents of the larger number of society publications will continue still for a very long time, but it is encouraging to notice that some of the greater foreign societies have long since differentiated along main lines in their publication, while within recent years a further specialization has been effected in a number of others, notably, for our own country, the California Academy of Sciences, and such differentiation is easily foreseen in others as their membership and activity increase through the formation of sections each devoted to some particular science, the more strongly represented and active sections being almost certain ultimately to secure the separate publication of their matter.

For the journals which do not emanate from learned bodies, the problem is a simpler one. We already have numerous examples of a primary differentiation into popular and technical journals. The former can hardly fail to be, for the most part, of miscellaneous contents, because they are intended to keep all persons interested in science at large informed on the advances which are being made in its several departments. Familiar illustrations of successful journals of this kind are Die Natur, the Naturwissenschaftliche Rundschau, Nature, Science Gossip, Science, The American Naturalist and the Popular Science Monthly, not to mention others of a list which might be greatly extended. Even among these, however, as the examples named may serve to show, there is a considerable specialization on subject lines, and the present issuance of Science and the Popular Science Monthly under one editorial management may be taken as representative of a process of evolution in active progress, by which even the less technical journals are differentiating into classes adapted to readers engaged in active scientific work and persons having an interest in but not directly engaged with such work.

One further differentiation that is becoming a pressing necessity is that which shall result in a considerable improvement in the specialist's means of keeping himself informed on what has been done in his own specialty. I do not refer to the popular or general presentation of the more striking results of current activity which can be obtained from the general journals or those devoted to each particular branch of science, but to something which of necessity must be limited to that branch and which must be complete. Many of the proceedings of societies and of the journals publish very helpful bibliographies at short intervals, and the Botanisches Centralblatt is in large part devoted to this purpose, while the Jahresbericht, taking more time than is possible for a current periodical, summarizes and indexes with much greater fullness current botanical literature. Unfortunately, the Jahresbericht is so greatly delayed that a period of several years elapses before its pages afford information on any given piece of work, and it is difficult to see how this can be otherwise, in view of the care which is expended in the tabulation and co-ordination of its contents; but without this tabulation and co-ordination, it does not seem to be impossible to secure a very prompt synopsis of all that is issued in botanical literature. The machinery for doing this is already organized in the bureau of the Centralblatt, and it is difficult to see why all that is needed cannot be supplied through this channel, if the publishers can be convinced that the botanical public would much rather subscribe for a bibliographic journal, in which all abstracts are of short length and synoptic character, than for one in which many abstracts are entirely disproportionate in length to the importance of the papers they refer to, to the exclusion of others, while the introduction of original matter forces into a supplementary journal no small part of the reviews that are given. Prof. Farlow has very well discussed this subject in a recent number of one of the botanical periodicals, and it is hoped that the action initiated at the Naturalists' meeting last winter, which is likely to be brought up by a committee report before this Section, may here find important support, so that either a separation may be secured, of the Centralblatt and its Beihefte into two journals capable of being subscribed for separately and permitting the desired completeness of bibliography, or other practicable means evolved for attaining this end.

Some years ago the members of this association listened with no little interest to Dr. Herbert Haviland Field's explanation for the purposes of his then proposed Concilium Bibliographicum, which has since begun operations in Zürich and I understand is prepared to include botany among the subjects that it handles. It is a matter for regret that the Royal Society's proposal for an international catalogue of current literature has failed to materialize for the time being, but it is possible that if a satisfactory purely botanical bibliographic journal cannot be secured, this scheme can still be put into practical motion. In one way or another, in any event, it is certain that some provision of the kind must be secured within a very few years.

However specialized, publications considered as a whole are in need of far more careful editing than they commonly receive. The author who prepares manuscript for publication is more likely than not to cast it in final form with reference only to what he says in it or what he himself may have already published or may expect to publish at some future time, and the result of this disjointed treatment is perhaps most readily seen when some subsequent compiler, let us say of a popular flora, copies side by side the descriptions of a number of writers. The most diverse phraseology is at once evidenced, although the compiler, on the basis of his own information, may have attempted to simplify the matter somewhat. Comparable things are treated in different paragraphic location; but similar facts are stated in dissimilar phraseology; and a character strongly emphasized under one species is not at all considered in another. In one paragraph a certain page of a certain book or journal is cited in one form, and in an adjoining paragraph in another form and perhaps under another author, and possibly even with a different page reference in case, as is often true, author's separates of the article quoted have been issued with individual pagination and even plate numbering.

At the Botanical Congress held in Madison in 1893, this and several other matters calling for uniformity of treatment in the interest of clearness were referred to committees, some of which reported at the next succeeding meeting of this section of the Botanical Club of the association. The increase in intelligibility and simplicity of bibliographic citations noticeable of late years is an encouraging sign that botanists are quite willing to attempt to work out on uniform lines these matters which are of interest to all who have occasion to consult botanical literature, so soon as the method of procedure in each case shall have been carefully codified with reference to the practical difficulties which each writer has to confront.

Among the editorial matters to which really this question of citation pertains, although it practically falls back upon the author, should be mentioned a comparable treatment of comparable facts expressed by diagrams, curves, formulæ, and the like. The tendency of large volume in any publication is to economy of space by the employment of symbols or abbreviations, which must be learned and borne in mind by every reader before the facts which they stand for are intelligible. If these symbols should be standardized for all writers who use this means of expressing their facts, it would result in added value for their work and in a great saving of the users' time. What can be done for symbols, however, cannot always be done for what are treated as abbreviations, because of the fact that the word abbreviated is different in one language from what it is in another; and yet there is no doubt that much improvement can be effected in this direction, while a perfectly uniform result for the entire world may be ultimately attainable by falling back upon the Latin language for words which are to be abbreviated.

Detailed matters of this kind are often considered too trivial to occupy the attention of a body like a section of the American Association, but I am convinced that the numerous discussions which have taken place before the Botanical Club and our own section have resulted in a much clearer general understanding of the proper meaning of many terms that most of us use almost daily, than would otherwise have been possible, and that each of us has profited to the benefit of his readers by the information elicited by these discussions; and I cannot conceive a more useful way of spending a part of the time of this body each year than in the discussion of subjects of this kind, carefully selected and referred in advance to members or committees capable of discussing them authoritatively from different points of view.

Some of the facts of plant distribution, whether referring to the occurrence of a given genus, species or variety over the earth's surface or at different altitudes, or to the minuter details of distribution demanded for an accurate presentation of some phases of ecology, demand the use of maps, more or less detailed according to the matter to be presented. Nothing is simpler than to so shade or color these maps as to indicate what the author desires to bring out, but, unfortunately, different maps dealing with the same general facts are usually colored very differently. Map evolution consists primarily in the indication of physiographic features, on which political boundaries are more or less artificially superimposed, the representation of geological structure, and the further indication on this foundation of the biological facts which are intended to be shown. The work of the physiographer and geologist is already done to the hand of the botanist, in most cases, and when it is not he is early confronted with the need of supplying deficiencies which exist. It is not many years since the geologists turned their attention to a standardization of their maps which is already simplifying geological literature. Will it not be better for botanists, who already know fairly well the main biological facts that are capable of expression on maps, to confer with the zoologists, who have comparable though different needs of map employment, and with the geologists and topographers, on whose work both can most profitably build, so as to secure an early standardization of method, than to wait until the otherwise necessary confusion due to independent individual practice shall have forced this upon them? I cannot conceive a better outcome of the conference to be held this summer on plant geography than the appointment of a committee to consider this question in detail, not only with reference to their own needs, but to the needs of the botanists at large and in consultation with those in other parts of the world who are considering the same problem and the best way of solving it.

If I have confined my remarks thus far to details of internal editing, I should not wish it supposed that other and more general matters do not exist which are worthy of equal thought. No small part of the confusion in citing publications comes from the issuance of the same matter in several different places, either at the same time or at different times, either similarly or differently paged, not infrequently with different titles, and sometimes under a title so phrased as to give no indication of the contents. Books are always likely to undergo revision between different editions and, unfortunately, this is sometimes true of different issues which do not purport to be editions, and an article once published in a journal or book which is not copyrighted becomes by common acceptance the property of the world and may be reprinted legitimately under the author's name, and properly with the further citation of the original place of publication, for an indefinite number of times, during which process it may undergo considerable modification. It is difficult to see how this can be avoided, and it is difficult to see how reprints can be cited otherwise than with reference to themselves and their original sources, but a great deal of confusion may be avoided if writers who have occasion to refer to reprints (in contrast to separates) will always indicate that they have done so.

We have fortunately in large part passed the age of secondary titles, and it is a matter for congratulation that it is now rarely necessary, when using a new book, to give a secondary or still more subordinate title as a means of specifying the particular work referred to; and the citation of older books makes the occasion for thankfulness that this is so very evident to all who use the library. In one respect, however, a great improvement is needed. Librarians, who are a very practical set of people whose purpose now is to make any book quickly accessible to anyone who knows either its author, title, or subject, have adopted somewhat arbitrary but very serviceable rules for cataloguing and cross-referring, intended to secure this end. With an isolated book comparatively little difficulty is found, but between distinct books, and articles in proceedings or other periodicals, there is an insensible intergradation, owing to the publication of series of various degrees of complexity, which are calculated either for the convenience of a certain class of readers, the glorification of the author, or the emolument of the publisher, or are necessitated by the great development of institutional research and publication.

I do not wish to cite examples of terrible things to be avoided, which even a casual inspection of the contents of any large library reveals, but I should not wish to pass the subject by without calling attention to the very great need of editorial reform which devolves upon those who are charged with publishing series, and particularly those whose publication responsibility is so great as to force upon them the unquestionably necessary establishment of such differentiated series. In a late number of the monthly Public Libraries, Mr. Reinick presents a suggestive statement of a librarian's difficulties in the arrangement and cataloguing of the United States government documents, which is worthy of perusal not only by librarians, but by persons who have occasion to cite such documents and those who are concerned with their publication. Some four years since, Mr. Frank Campbell, of the library of the British Museum, published a series of essays under the collective title "The Theory of National and International Bibliography," in which the question here raised is given instructive if perhaps not always final treatment. No one who has occasion either to arrange, catalogue, or use the publications of the various branches of the Indian government or of our own government, or the publications of our several States, or of the agricultural experiment stations with which each of these States is now provided, or, finally, the contributions which are emanating from the more important research centers, chiefly in the form of separates or reprints of articles originally published in magazines or the proceedings of learned bodies, can fail to see at once the necessity for a collective treatment of all publications organically connected in their origin, and the fact that Mr. Reinick's device of stamps by which the librarian can supply necessary information not printed on the title page is necessitated if the members of a given series are to be unquestionably brought together, carries between the lines a suggestive commentary on the existing facts.

I hope that I have sufficiently brought out my own belief that the writer, the editor, and the publisher, who frequently work independently of one another, are in reality tied together by a very close bond, in so far as they are aiming at the real purpose of publication, its usefulness, and that the librarian, the indexer, and the reviewer are no less necessary links in the chain between the publishing investigator and his numerous and increasing readers. The practical recognition of this intimate connection is no less necessary for the promotion of the rapid advance of science which the present activity of investigators promises than the unification of the methods of the investigators themselves, and can no doubt be secured in the same manner.

In conclusion, I wish to ask attention for a few minutes to a matter of prime interest to all botanists, since it will probably affect the very prosecution of many of their studies before the next century shall have been closed. I refer to the protection and preservation in every possible way of our native and natural vegetation. To the systematist, the physiologist, and the morphologist, this is alike of importance. Agricultural lands, in the main, of necessity must have their native plants replaced by others if the latter are more valuable to man, as surely as grazing lands have been stocked with cattle after the extermination of the less useful bison. But the erection of an agricultural practice, based on a preliminary clearing of the ground, is quite different from the denudation of the land without further purpose than the utilization of its native products. Primarily the question is an economic one, and as such it interests the community at large; but it is also a question of the deepest concern to science. Climatology, the past, present, and future geographical distribution of animals and plants, and ecology and evolution are so clearly connected that their devotees possess a common interest in the preservation of natural conditions, at least until the factors in biologic nature shall have been directly ascertained and correlated; and I need scarcely add that what has thus far been done in this direction is little more than a rough blocking out for the future. Hence it is that local societies for the protection of animals and plants are worthy of general support in their efforts, and that the widespread forest protection movement, which is too commonly looked upon as simply an economic or sentimental matter, should receive the united encouragement and support of naturalists and meteorologists as a movement the success of which alone can perpetuate for any great time the conditions upon which much of their profounder study is to rest. This association is to be asked to endorse an effort for the local preservation of the red woods over a considerable area in Central California, and the location of the forest reserve in the southern Appalachians. It is to be hoped that whatever action may be taken shall rest not upon hasty im-

pulse, but upon such recognition of the vast scientific as well as utilitarian importance of this movement as shall insure the permanence of our interest in every step of the kind which may originate in the future.

FRESH WATER AQUARIA.

By L. MURBÁCH.

THE lover of Nature, taking his early spring walks, often feels the desire to cultivate a nearer acquaintance with the living things that he sees in ponds and pools along his way. He may dip up samples here and there, taking some water weed and a string of the jelly beads containing toads' eggs, place them in glass jars or aquaria at home, and gain further pleasure, for a few days at most, and then the whole mass becomes foul and is thrown away. His ill-success is due to the improper balance between animals and to the popular misconception that an aquarium with animal life should be uncovered so that the animals can get air to breathe; and the remedy lies in keeping the aquarium, once properly balanced from one spring to another, so well covered that scarcely any evaporation of water can take place. To this, then, may be added new organisms from time to time.

None of the numerous notices on the keeping of aquaria that I have seen describe permanent aquaria without changing the water; yet this is one of the most desirable features—to keep the aquarium, year in and year out, for observing the interesting succession of forms, often including representatives of animal groups from Protozoa to Crustacea, with an almost equal diversity of aquatic plants.

Some of the pond scum (algæ), drawn by light and adhering to the side of the glass, may be made to decorate the side of the aquarium with almost any pattern in green—letters, or your monogram if you choose. Some of my experience may be useful to the reader, and I gladly give it for what it may be worth.

Seeing the algæ in my largest aquarium accumulate on the side most strongly lighted, it occurred to me that they might be made to form a definite design by regulating the light. First a stencil of paper or pasteboard was used, but as this was not permanent enough, one of my students, living next door to a tinsmith, cut out the monogram of our school and attached it to the outside of the aquarium, having previously cleaned the inside with a scraper. In a few weeks the letters "D. H. S." were sharply marked by the sun's ray pencils and the microscopic green plants within. (See figure in Journ. Applied Micros., July, 1899, vol. ii., No. 7.) The stencil may be removed at any time for inspection, but should be kept in position the half of each day, while the strongest light falls on the aquarium to keep the letters from being obliterated. This experiment serves to illustrate the movement of green plants toward the source of light, and has interested many of our visitors.

Such balanced aquaria also have a practical value in the schoolroom or laboratory; each one will have its own fauna, and may serve as a source of animalculæ, Amœbæ and other Protozoa so highly prized by the young teacher, and larger animals and plants for demonstration, experiment or research, in more nearly their natural environment, than those kept in water changed daily. This last spring we had a nice illustration of this fact; some fairy shrimps (Branchipus) were placed in a glass jar with water and plants of their habitat, and a few were placed in one of the balanced aquaria of the same size and receiving the same lighting. Those in the first jar died in a few days (the common experience of every one who has tried to keep them in the laboratory for demonstration), while those in the aquarium lived three times longer.

In one small aquarium jar, set up over a year ago, containing mostly diatoms, Oscillaria, some water fleas and Rotatoria, there has been a good supply of Amœbæ for class use. Another larger one, kept over two and one-half years, in which a large snail, some water weed, and smaller animals constitute the balance, furnishes sun animalcules for demonstration. The largest one, with glass plate sides, slate bottom and ends, has been kept nearly two years without change or addition of water. It is stocked with aquatic plants, Cladophora, Myriophyllum, Lemna, Wolffia, Anacharis, and many single-celled algæ. The largest animal representative is a so-called "bull-head" (one of the species of Uranidæ), about four inches long, kept principally for the balance, and because he needs no further attention than a few earthworms every few days. In this aquarium fresh water polyps, Polyzoa, and other interesting forms appear in their season.

In speaking of the time these aquaria have been kept, it is to be understood without changing the water but covered in such a way as to require very little or no additions of water to supply evaporation.

The aëration of the water for the breathing of animals will be readily seen to come from the oxygen given out by the plants while they feed (during photosyntax) on the carbonic acid gas given out by the animals. The only thing needing attention is the feeding of such animals as cannot find their source of food in the aquaria themselves, and this should be done so carefully that no food is left to decay.

For acquaria almost any kind of glass vessel that can be securely covered against dust and bacteria may be used—jam jars, battery jars, culture dishes and globes for the smaller window aquaria; window glass, properly cemented into wooden frames that are kept coated with paraffin or asphalt varnish, for a medium size; and slate bottom and ends, with plate glass sides, for the larger though more expensive ones.

In setting up the aquaria it is better to begin with water from some clean pond containing considerable plant and animal life. Fill up to within a few inches of the top with water, and then add about one-twenty-fifth its bulk of plants and animals; or hydrant water may be used, adding some plants, and later the animals desired. Where there is no choice, snails and Crustaceæ are the most convenient for use, unless they are hostile to the organisms desired for experiment. The snails feed on the plants, giving these carbonic acid in turn for food, while the Crustaceæ feed mostly on the débris from other organisms.

If the animals keep near the surface, too many are probably present, and some must be removed or more plants added. When the plants become yellow they are too abundant or have not had light enough. In many cases the water becomes foul on first setting up the aquarium, and as this is one way of obtaining certain desirable results, keep it covered until the foul odor disappears, and if new plants do not appear in time, add plants and animals to suit, and it may prove to be the best aquarium you have. Marine Protozoa have been kept this way in jars brought from the seashore several years ago.—The American Naturalist.

THE GERMAN ANTARCTIC EXPEDITION.*

THE German Antarctic expedition will leave Europe, in a single ship, in the autumn of 1901. The simultaneous dispatch of a second ship is not proposed, as this does not appear to be necessary, either for the solution of the scientific problems or for the safety of the expedition. A second vessel would be expedient only if it were intended to carry out oceanographical researches around the Antarctic area at the same time as a southward advance is made by the first ship. This is rendered the less necessary, on account of the work which has been done by the German deep sea expedition in Antarctic waters south of the Indian Ocean, the side on which the German expedition will endeavor to penetrate the ice.

The designs for the Antarctic ship have been completed with the advice of the Construction Department of the Imperial Navy. The building of the ship has been undertaken by the Howaldt Works in Kiel, which, in response to the circular inviting estimates, worked out an admirable plan. In designing the vessel special attention has been paid to seaworthiness, on account of the severe storms and high seas which prevail in the Southern Ocean; and, of course, she will be made as strong for ice navigation as it is possible to build her. The necessary strength will be secured by a system of internal supports and a triple planking of oak, pitch-pine, and green-heart. The hull will not be so much rounded as in the case of the "Fram," such a cross section appearing unsuitable for a ship which will have to encounter heavy seas, and the necessary resistance to ice pressure may be obtained with a somewhat fuller form. It need not be said that the vessel will be built entirely of wood. She will be rigged as a three-masted top-sail schooner, and will be provided with an engine and two boilers of power sufficient to insure a speed of seven knots, and more, if necessary.

The dimensions of the ship have been decided upon after taking account of the number of the scientific staff, officers and crew who will be carried, as well as the time which the expedition is expected to be absent. The scientific staff will be five in number, and there will be five officers, including the first engineer and eighteen to twenty men. The expedition is expected to be absent for two years, but it will be equipped for three, in case it should be found necessary to prolong it. These requirements demand a length of 151 feet, and a depth of about 16 feet below the water line. The cost of building the ship will be about £30,000.

The scientific staff of five, including the doctor, will be so chosen that each important branch of science will be represented. Each member of the staff will be able himself to carry out all the work of his own department; but every one will be capable of assisting in the special work of any other, or, if necessary, of taking his place.

The author of this article, who has been appointed leader of the expedition, will undertake the physico-geographical, oceanographical, and geodetic work; Dr. E. Philippi, of Breslau, will take charge of the geological, palæontological, and chemical investigations; Dr. E. Vanhöffen, of Kiel, will act as zoologist and botanist; Dr. H. Gazert, of Munich, will be the surgeon; and the fifth member of the staff, who will have charge of the magnetic and meteorological observations, is not yet selected.

The five officers, including the captain and also the first engineer, will be fully occupied with their duties in the management and navigation of the ship during the voyage. But during the year to be passed at the scientific station, which will be founded by the expedition, and near which the ship will remain, the officers will take such part in the scientific work as may be decided at the place and time by the leader of the expedition. They will probably be occupied principally with astronomical observations at the station, topographical and hydrographical surveys in its neighborhood, and with pendulum and magnetic observations on the land journeys and at the station. The crew also, the amount of whose assistance to the scientific staff during the voyage must be regulated by their duties on the vessel, will be allocated, at the winter quarters, to the different members of the scientific staff for training, so that they will be able to lend a hand on occasion. The captain, officers and crew have not yet been appointed.

As indicated above, the work of the expedition will be divided into two parts; one carried out on board during the voyage, the other on shore at the winter quarters. The projected route of the expedition is of importance with regard to the first part. It is intended to enter the Antarctic from the direction of Kerguelen, and the details of the route, particularly the deviations from a straight course, are planned with a regard to oceanographical, geological, and magnetic requirements.

The oceanographical considerations are the existing lacunæ in our knowledge of the depths of the sea; the geological are the collection from various island groups of specimens for comparison with those obtained in the Antarctic; while the magnetic conditions make it desirable to cut the lines of equal value of the various magnetic elements in as many points as possible. Taking all these conditions into account, I propose not to run directly south from Kerguelen, but first to sail eastward to about 90° E., and then turn toward the south, as on that meridian deep-sea soundings are wanting. For the same reason the route from Cape Town to Kerguelen would be curved southward between Prince Edward and Crozet Islands, while, on the other hand, on the return voyage, the line between south Georgia and Tristan da Cunha will be straight, because it is desirable to investigate the southern extension of the great Atlantic rise.

The point which the German expedition has in view for commencing the penetration of the Antarctic region is the still hypothetical Termination Island. The British expedition being intended to follow the northern side of Wilkes Land, the east coast of Victoria Land, the great ice wall, and beyond that to investigate the Pacific side of the Antarctic, the German expedition is planned to strike southward from Termination Island in order to discover the western side of Victoria Land, and to clear up its possible connection with Kemp Land and Enderby Land, and ultimately to sail around the Atlantic side of the Antarctic and investigate, wherever it may be possible, the southern extension of the Atlantic Ocean and Weddell Sea. If the two expeditions carry out this common plan, the geographical division of the work gives the best basis for co-operation in all other questions.

The second part of the German programme is the establishment of a scientific station in the Antarctic, at which a full year will be spent in geographical and biological work, and which will serve as a starting point for longer or shorter land journeys. It is, of course, impossible to say where this station will be, as the site must depend on the results of the discoveries made in pushing southward. An effort will be made to establish it on the west side of Victoria Land, where one may expect to find an extensive land surface which will offer a favorable opportunity for carrying on the various researches; such a position would be particularly desirable for magnetic observations, on account of its proximity to the south magnetic pole.

The great Antarctic ice cap could probably be best reached and explored on an extensive land which might, perhaps, enable one to travel toward the South Pole itself. An extensive land also offers richer opportunities for the study of plant and animal life, if such exist, and also for geological phenomena than separate islands; and observations on gravity also are of more value on a large land surface. Briefly, an effort must be made to build the German station on the coast of an extensive land, and for this purpose the west coast of Victoria Land appears the most suitable, as it is the intention of the British expedition to land some of their party on the eastern coast, and this proximity will afford an opportunity for effective co-operation.

I can naturally only refer briefly to the particulars of the projected expedition, the main plan of which has been sketched above. The fundamental fact is that the scientific preparation will be so complete that every kind of work can be carried out which the present condition of science requires, and for which time and opportunity offer. What will actually be done must naturally be decided on the spot. The members of the expedition must be so prepared that they can distinguish the important from the less important, the necessary from the merely desirable; in a word, the purely Antarctic, if one may so say, from what could be carried out equally well in other parts of the world. The desiderata of Antarctic exploration are innumerable. It is essential to make a proper choice, and this is the first object to be served by thorough preparation.

For this purpose general instructions likely to be of service will naturally be subject to the initiative of the investigators themselves when they arrive at the field of work.

I shall here only mention a few of the problems with which the German expedition will be occupied. Among these, geographical studies will take the first place, since they supply the necessary foundation for all other investigations. An effort will be made, not only to lay down the coast lines, but, in some places at least, to follow out the general contour, and wherever it is possible to study the forms of the land. The ice which gives its special character to the Polar regions will be studied as regards its nature and structure, its temperature, its transport of land waste, and its movement, and this should permit conclusions to be drawn as to the land which it covers. With regard to the sea, soundings will be made in the regions where they are still wanting along the intended route, that is, in the whole area south of 40° S., and in some places also to the north of that parallel. It has already been pointed out that the route has been chosen with special regard to the regions where soundings are most required. Of course, observations will be made at the same time on the physical conditions of the sea with regard to temperature, density, composition of the water and the deposits, color, dissolved gases, and circulation. It would be of great value also if pendulum observations could be carried out during the voyage, as it is intended to make this a special feature of the work on shore, and particularly in the neighborhood of the station.

The geologist's duties will include the study of the samples of deep-sea deposits brought up by the sounding rod, and also the chemical investigation of the sea water, the physical properties of which will be studied by the geographer. The geologist will, of course, be busily employed at every landing. He will take part in sledge journeys from the land station, along the coast and occasionally toward the interior. Special attention will be devoted to fossil plants, if such should be found to exist in the far south, as well as to all other palæontological and petrographical questions which are likely to allow comparisons to be made between the South Polar region and the rest of the world.

The expedition promises a particularly wide field of work to the zoologist and botanist. His prospective collections should include every form which can be preserved and carried on board the ship, and they will apply equally to the fauna and flora of the land, of fresh water lakes, of the littoral zone and of the deep sea. Special attention will be paid to the seasonal differences in the occurrence of the various animal forms, and to their development. Biological investigations will, of course, be carried out in close relation to the physical, in order, for example, to recognize the dependence of plant and animal life on the conditions of the sea water and the nature of the currents. For this purpose vertical and closing tow-nets have been planned, to be used in the different regions, and from the station at different seasons. By comparing the results and those of surface gatherings at the various seasons, data will be obtained for the study of ocean currents. As the expedition is not primarily intended for deep-sea investigation, it is not proposed to carry

* Translated from Prof. Von Drygalski's MS. by Dr. H. R. Mill in Nature.

on the deep-sea observations to a depth greater than a thousand meters. The gear required for dredging at greater depths would be too cumbrous an addition to the necessary equipment of the ship. This limitation is the less serious since the deep-sea fauna in warmer regions reaches up to within 700 meters of the surface, and in cold regions still higher.

The surgeon of the expedition will, in addition to the treatment of such illness as may arise, endeavor to collect information on polar hygiene by a careful study of the state of health of the members of the expedition. These observations should enable him to advise the leader on many questions connected with the arrangements and manner of life of the expedition. Further physiological studies will also be carried out, and the surgeon will assist the biologists in observations on the development of various organisms, and especially with bacteriological research.

The magnetic and meteorological work of the expedition, like that of the other departments, will be the sole charge of one member of the staff, but he will be assisted in reading the instruments and in other mechanical work by members of the ship's company, and the officers will co-operate in the various physical observations at the station.

Regular meteorological observations will be taken during the voyage every four hours, if possible, and at the station three times daily. For wind, cloud, and similar phenomena, it will be desirable to organize a system of continual observation of the sky. Self-recording apparatus will be employed for pressure, wind, temperature, humidity, and duration of sunshine, and, in case these should become ineffective through extreme cold, their place will be taken by as many eye observations as can be managed. Special observations during the cruise will be required for such questions as the time of the daily maxima at sea, the best arrangements for a rain-gage on board, twilight phenomena in the open sea, waterspouts, etc. At the station it is intended to carry out observations on the upper regions of the atmosphere, but to what extent and in what manner cannot be decided until the balloon equipment is definitely arranged. A captive balloon will certainly be carried for the purpose of geographical reconnoissance; sufficient gas to fill the balloon about ten times, and a lifting power which will make it possible to raise an observer about 500 meters, seem to be all that is necessary. It appears to be better to carry the hydrogen for filling the balloon in compressed form rather than to prepare it on the spot, that is, if compressed gas can be carried safely on board, a point on which further information is necessary.

The programme for magnetic work is not yet definitely settled. Pending the results of further consideration and advice, the following may be looked upon as likely to form part of it. During the voyage the magnetic elements will be determined at least once a day with the standard compass, the Fox apparatus (dip-circle), and perhaps also with the deviation magnetometer. The magnetic apparatus will be installed upon the navigating bridge of the ship, in the neighborhood of which no iron will be used in the construction. At the station variation observations will be made with photographic registering apparatus, controlled by direct readings. Magnetic observations will also be provided for on the land journeys.

Particular attention will be paid to the study of the Aurora Australis, especially with regard to its form and height, perhaps also to its spectrum, and the coincidence of auroral displays and magnetic disturbances; but the measurements of earth currents is considered beyond the scope of the expedition.

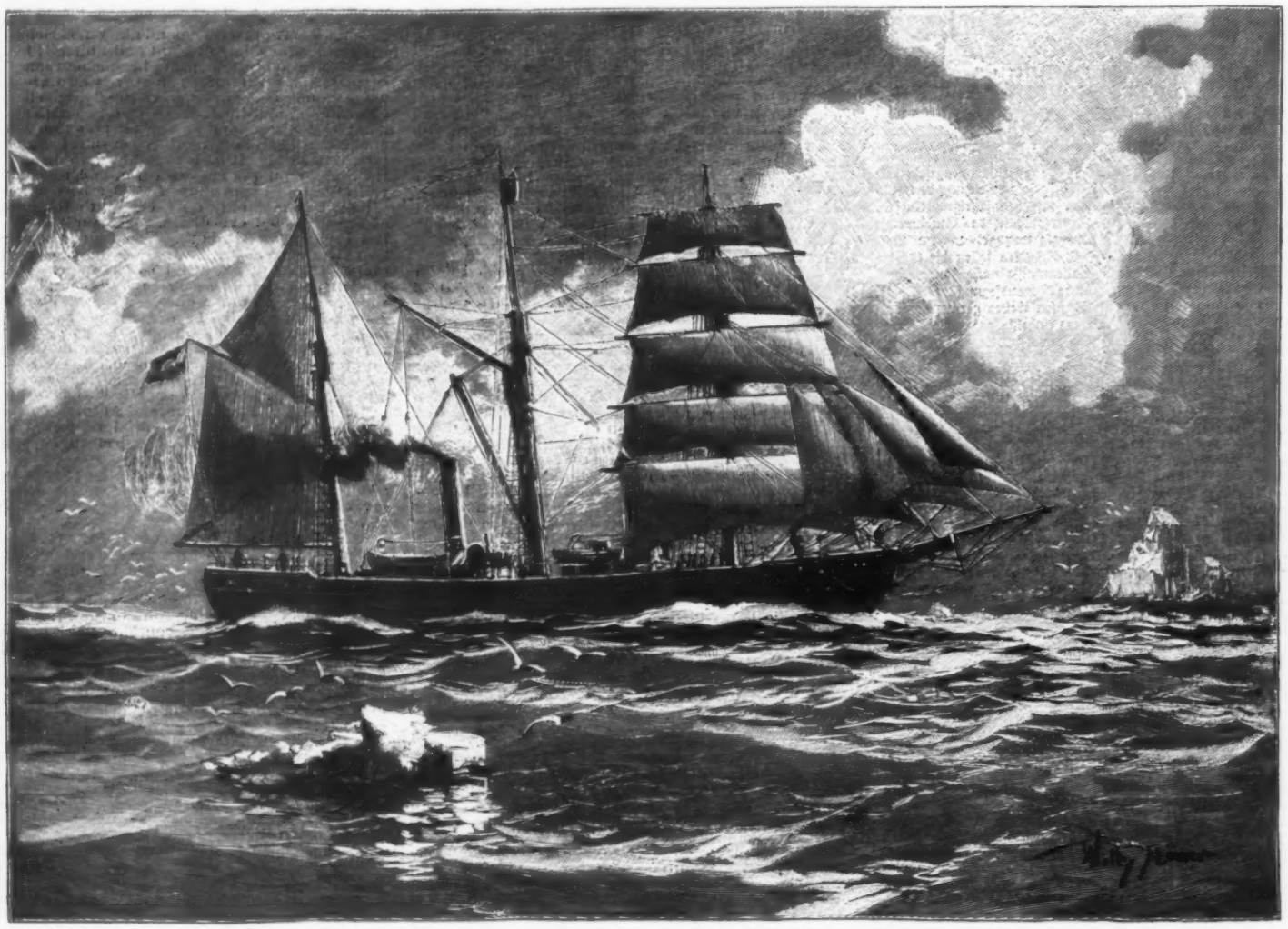
In connection with the arrangements for magnetic work at the station there will be provision made for for seismological observations.

Astronomical determinations of latitude and longitude and geodetic measurements will, of course, be carried out. During the voyage, and on land journeys, the former will be fixed by means of the prismatic reflecting circle; but at the station, where a more exact astronomical determination is necessary, a large transit theodolite, and a good telescope for occultations, will be employed. At the points on the shore connected with the station a similar universal instrument, or a prismatic circle, will be utilized. Continued time determinations will naturally be carried out in connection with absolute observations for latitude and time conversions; pendulum observations will be made as often as possible. Geographical surveys on the scale of about 1 : 50,000 will be desirable in the neighborhood of the station and in such other places as may be interesting from a cartographical point of view, or which present important physical phenomena, such as ice movement or ice structure, or where the pendulum observations make a special survey desirable. For this purpose the smaller or even the larger universal instrument will be employed, as well as a Stampfer's level with staves. Opportunities may also occur for the use of photographic surveying instruments. Attention will be given to the anomalous refraction which, from the observations of previous Polar travelers, appears to be due to some atmospheric conditions different from any that occur in our latitudes.

This sketch of the German programme naturally does not exhaust the problems with which we have to deal. It was, however, less my intention to give an account of the work which we hope to attempt than to indicate the directions and lay down the limits of our proposed operations, as that will be of service in finally settling the methods of international co-operation. From this point of view the large number of the problems mentioned does not appear dangerous. It might, however, become so if the expedition were tied down to definite instructions, and not left free to act as time and opportunity demand. It seems the wisest course to provide a complete equipment for all branches of scientific work, opportunities for doing which may offer themselves, and leave it to the leader of the expedition to decide on the spot and at the time what work will be done.

I have already pointed out that the basis of international co-operation has been laid in the choice of routes and the consequent division of districts within which the land stations are to be established. The German expedition takes the Indian Ocean and Atlantic side, and the British the Pacific side of the Antarctic area. An expedition from a third side would find a wide and important field of activity to the south of South America. As regards physico-geographical, geological, biological, and gravity observations, scarcely any further co-operation is required than the simultaneous carrying out of observations in the different areas. Should the British expedition include a second ship, it would be possible to carry on biological deep-sea research round the Antarctic area over a much wider circle than we can attempt with one vessel.

A clearer understanding is still required for co-operation in meteorological and magnetic research, to decide, in the first place, the scope and the methods of research to be pursued during the voyage and during the year's sojourn at the land station; and, in the second place, what additional work beyond that undertaken by the two expeditions it may be possible to arrange. My scheme for the first of these plans is already sketched out as far as regards the meteorological work; the magnetic programme requires still further consideration. The understanding with the British expedition on this question is now under discussion. For both branches of science the choice of routes and of districts in which the stations will be placed is very appropriate, as observations will be made in the vicinity of the south magnetic pole on two sides, and both stations lie in the probable position of the Antarctic anti-cyclone, which appears to extend farthest north on the Indian Ocean side. The second point which concerns the organization of simultaneous observations outside the Antarctic area, is still unsettled. The British Antarctic expedition has already in view the establishment of a scientific station in New Zealand, while Germany is planning a branch station on Kerguelen. These would furnish valuable data for comparison with the results obtained by the expeditions themselves. Yet, we must go further, but not so far, I think, as M. Arctowski suggested in his paper to the British Association at Dover. It is greatly to be wished that during our expeditions the Observatories of Melbourne and Cape Town would undertake similar observations, and it would also be a good thing if a station could be placed near Cape Horn or in south Georgia, as well as one in the North Polar region, say at Bossekop. Thus the problems of the Antarctic regions could be attacked simultaneously from without and from within.



STEAM BARKENTINE OF THE GERMAN SOUTH POLAR EXPEDITION.

A resolution of the St. Petersburg Meteorological Congress, in August last, in favor of such co-operation was received with pleasure. The International Geographical Congress at Berlin went further, and unanimously approved the appointment of a committee charged with: (1) Laying down the scope and the means of investigation for the magnetic and meteorological work of the expeditions; (2) the organization of similar series of observations on the expeditions, and, perhaps, also exerting influence for the establishment of observations at other places.

On the German side, the members of this joint committee are Profs Hellman v. Drygalski, Eschenhagen, and A. Schmidt; and on the British side Dr. R. H. Scott, Dr. Buchan, Prof. Schuster, and Capt. Creak. The programme prepared on the German side for the meteorological and magnetic work has already been sent to the British members of the committee, to be considered by them, and afterward discussed and

definitely settled by the whole committee. We may expect in this, as in all other points, a complete and useful co-operation between the two expeditions.

For our engraving we are indebted to the Illustrite Zeitung.

A VOTIVE ADZE OF JADEITE FROM MEXICO.

IN the archæological collections from Mexico and Central America, the American Museum of Natural History possesses several specimens of carved jadeite of a remarkable character. Among these the so-called "votive" adze in the Kunz collection, secured some time ago, is one of the most interesting. It has until now never been figured, but was described by Mr. Kunz in his work, Gems and Precious Stones of North America, pp. 278–279. In the accompanying illustration it is figured two-thirds its natural size. The following account appears in the above-mentioned work:

"Among the more remarkable jadeite objects of Mexican origin is an adze described by the author, believed to be the largest yet found. On its face is figured a grotesque human figure, and, for so hard a material, the workmanship is excellent. It is said to have been found about twenty years ago in Oaxaca, Mexico. It measures 272 mm. (10⅞ inches) in length, 153 mm. (6 inches) in width, and 118 mm. (4⅝ inches) in thickness, and weighs 229·3 Troy ounces. Across the ears, 153 mm. (6 inches); across the lower axe end, 82 mm. (3¼ inches); height of head to neck, 158 mm. (6¼ inches); height from chin to foot, 115 mm. (4½ inches); and the legs, 50 mm. (2 inches). From the back a piece about 160 mm. (6¼ inches) long and 50 mm. (2 inches) wide has been removed. The color is light grayish-green with a tinge of blue, and streaks of an almost emerald-green on the back. In style of ornamentation it very closely resembles a gigantic adze of granite, 57 cm. long and 34 cm. wide, mentioned by A. Chavero [Mexico à través de Los Siglos, Mexico, 1886, p. 64], and it has almost a counterpart in the green aventurine quartz adze now forming a part of the Christy Collection at the British Museum, and formerly in the possession of Percy Doyle, of the British Diplomatic Service, differing from these two objects, however, in having no ornamentation on the forehead, and in having four dull markings on each ear, one under each eye, and one near each hand, which seemingly could have served no other purpose than to hold thin plates or films of gold, which the polished surfaces would not do. If this was so, no trace of the gold can now be seen. From all appearances, this adze was shaped from a bowlder, since weathered surfaces, such as appear on all sides of it, would be found only on an exposed fragment. The lapidarian work on this piece is probably equal to anything that has been found, and the polish is as fine as that of modern times. One point of interest, which should not be lost sight of, is the removal of a portion which has weighed fully two pounds. . . .

"Fully one-eighth was removed from the back of this adze, and the manner in which the instrument used in the removal was held has produced a rounded cut on each side, lending probability to the supposition that some abrasive was employed, drawn with a string held in the hands or stretched across a bow. If the Aztecs knew of the existence of this sapphire, we can more readily understand how they worked so large a mass of tough and hard material. So far as the writer has been able to ascertain, no similar object of equal magnitude and archæological interest exists. Neither the Humboldt celt, the Leyden plate, the Vienna adze, nor the one in the Ethnological Museum at Dresden, which weighs only seven pounds, and is entirely devoid of ornamentation, can compare with it.'

All of the salient features of the adze are well brought out in the plate. The dull markings mentioned by Mr. Kunz were to be seen only by a close examination, and I have found other markings which make a unit of the whole design. These lines are rendered visible to the casual observer by the whitening. It will be observed that the edge has what appears to be teeth, possibly symbolizing the biting or cutting nature of this part of the votive adze. The mask-like face, with the upper jaw represented pressed upward against the nose, is characteristically a feature of southern Mexican art and from the presence of sharp canine teeth apparently represents a tiger mask. That this object was used as an idol, or for ceremonial purposes, is clearly evident from its size, weight, and symbolism. During the past ten years hundreds of jadeite objects have been found in the State of Oaxaca, but up to the present time no bowlders or rough pieces of this material have been found. It is an interesting problem as to the source of jadeite in Oaxaca. From our present knowledge it seems extremely probable that a careful search made in the Department of Villa Alta, or possibly in the Misteca, would reveal the place where it was obtained by the Indians.—MARSHALL H. SAVILLE, in Monumental Records.

ANILINE DYES SOLUBLE IN FATS.

By DR. MARKFELDT.

SINCE the very commencement of the aniline dye trade this comparatively new industry has steadily continued to increase from year to year, not merely on account of the infinite variety of colors, often surpassing those afforded by nature, which it furnishes, but especially because of the strength of the dye stuffs and the facility with which they are used. In all branches of the coloring business it is necessary to produce articles which please the customer's eye, and the achievement of this object depends in a very large number of cases upon a proper choice of the dyes or pigments to be used in their manufacture. In the course of time people have been accustomed to demand a supply of natural products with a special color, different from that which properly belongs to them, without troubling their heads about the fact that they must, therefore, be artificially dyed.

Of late a large number of artificial dyes have become used on a very large scale in all those trades which deal with oils and fats, either in the way of extracting them from their natural sources and putting them upon the market, or in the direction of elaborating them into various composite commercial articles. For example, substances have sometimes to be added to destroy the fluorescence of certain oils. For this purpose nitronaphthalene, a body obtained by acting upon naphthalene with nitric acid, was at one time the only substance used. Of late, however, it has been completely replaced by a dye, fluorine, which has shown itself far more suitable for the purpose, especially for machine oils. Such an extremely small quantity of the dye as 1 to 2 pounds per 20,000 pounds of oil is ample to produce the desired effect.

We propose to discuss in this article, the artificial dyes which are used for dyeing fats, oils, stearine, oleine (oleic acid), palmitine, ozokerite, ceresine, wax, tallow, paraffin, etc., and those put upon the market under the name of fat, Soudan-, fliphat-, Ceresine-, turpentine-oil, and resinate-colors. They must be placed in the following three classes:

1. The basic dyes.
2. Certain azo dyes made from phenols.
3. The so-called resinate-dyes.

Class I.—Most of these as they are put upon the markets are hydrochlorates, from which the colored bases can be precipitated by caustic alkalies. The bases are then filtered off, thoroughly washed, filter-pressed, and dried at low temperatures (about 50° C). The commonest bases in general use are auramine, chrysoidine, safranine, fast blue, victoria blue, induline methyl violet B and 6 B, malachite green, brilliant green, bismarck brown, and nigrosine. All kinds of shades can be got by suitable mixtures made from among these. The bases are either sold as such in powder or in highly concentrated solution, or made up into small dice-shaped pieces by fusion with the proper quantity of stearine. They are also sold dissolved in oleine. They are much used, especially in the dyed manufacture of stearine candles. Candles are either in the mass before moulding, or in dipped candles the last dip is made into dyed grease. Moulded undyed candles also are given a dip into dyed grease. The latter method is chiefly used for wax and ceresine, the former for stearine, except for the larger kinds of stearine-candles, particularly the so-called "boudoir candles." A good effect is produced with these candles, as the dyed mass accumulates mostly in the grooves, which then appear darker than the rest.

Mineral colors have the defect that they make the candles burn badly. Some of them, such as those containing arsenic or mercury, must not be used, as they cause the candle to give off poisonous fumes while burning. The color-bases named above have the special advantage for candle dyeing that they enter into chemical combinations with the stearic acid present. This explains the great solubility of these dyes in the fat.

These dyes are used with stearine by melting the latter and adding the coloring matter to it at 60 to 65° C., from 2 to 10 pounds to every 20,000 pounds of stearine. Great care must be taken not to overheat the mass, or the dye may decompose. Blues generally change to a brick red, but recover their color on cooling. Some colors which are very fast on textile fabrics soon bleach when dissolved in stearine, sometimes completely in a few hours. This is particularly annoying when it happens to only one of the dyes in a mixture. Thus, for example, yellow is generally added to brilliant green to give it a warm tint, but the green soon fades, and only an ugly greenish yellow is left. Care must be taken, therefore, in using mixtures, to make them solely from dyes of equal permanency under the circumstances. In the above case, a mixture of fast blue and auramine gives far better results. Black soluble in oil is used in specially large quantities. It is procurable in two shades, blue black and deep black.

The latter is prepared by mixing nigrosine with chrysoidine, a bazic azo dye, and is sold either in powder as deep black F black extra concentrated, or mixed with stearine as black F in pieces, or dissolved in oleine as liquid black F.

In the production of black candles, which are sometimes used in funeral ceremonies, paraffin dyed black with anacardium was used till within the last few years.

The paraffin was heated nearly to boiling, and some of the shells were then soaked in it. The paraffin then dissolves a resin out of the shells, and acquires a dark brown color, which becomes a dead black on cooling. Nowadays, deep black F supplies us with a far more convenient method of making black candles, which can be ornamented with silver as drawing room candles. Deep black F extra concentrated is also used for dyeing mineral oils, vaseline, etc., after it has been dissolved in oleine. In this form it is extensively used in the manufacture of wagon grease.

The only other use of this class of dyes in powder is in dyeing oils and fats of an acid nature, such as oleine and stearine. If they are to be used for dyeing neutral fats, wax or paraffin, they must first be dissolved in oleine or stearine.

Class II.—This is the most valuable of the three classes, as it can be used for all fats and oils indiscriminately. They dissolve easily in stearine, oleine, palmitine, ozokerite, wax, tallow, paraffin, fats, and oils, and also in alcohol. Hence they are extensively used in all trades making use of any of the above substances. They are all made by diazotizing bases and then combining them with 'phenols in alkaline solution. The principal phenols employed for the purpose are phenol itself and betanaphthol. In a few cases, alphanaphthol and resorcin are made use of. Large quantities of these azo-dyes are exported to China, in which country they are much used for dyeing wax tapers. As in tex-

A VOTIVE ADZE OF JADEITE FROM MEXICO, SHOWING FRONT, BACK, AND SIDE.

tile dyeing, the azo dye principally in demand is red, and the Chinese import particularly ceresine red, alias alipha red or red B extra concentrated, which is prepared from amidoazotoluol and beta-naphthol. Amidoazobenzole gives with beta-naphthol a dye of a somewhat yellow shade.

The raw materials of these oil reds, amidoazobenzole and amidoazotoluol, are themselves soluble in fats, but being of a basic character, belong, like bismarck brown and crysoidine, to Class I. They are sold under the name of butter yellow, and, as the name implies, are used for dyeing butter. They are prepared somewhat differently from the other azo dyes. Besides the dyes above mentioned and combinations of aniline with phenol, with alpha- and with beta-naphthol, of ortho-toluidine with alpha- and with beta-naphthol, of alpha-naphthylamine with the naphthols, of aniline and of pyranitraniline with resorcin, and of safranine, a diazotizable basic dye, with beta-naphthol, are also used. Finally, the diamines (benzidine, toluidine, and dianisidine) are used in combination with the phenols. The production of these compounds is a fairly simple matter, and the necessary apparatus is not expensive. On a large scale, mechanical stirrers have to be used. To insure good solubility the dyes must always be carefully dried, and very finely powdered.

Class III.—The resinate dyes belong to the great class of color lakes, and are prepared by dyeing solutions of rosin soaps with basic aniline dyes, and then precipitating the lake with a metallic salt. The rosin soap solution is made by boiling the purest colophony obtainable with a solution of caustic soda and carbonate of soda for about an hour, with an arrangement for condensing the steam and returning the water to the boiler, or, if the process is carried out in an open pan, adding water from time to time to keep the original volume of liquid unchanged. The pan should be much larger than is required to hold the materials, as they froth a great deal at the beginning of the process. The solution of soap is finally diluted to 50° B. with cold water, and dyed with a filtered solution of basic aniline dye, such as fuchsine, methyl violet, brilliant green, safranine, chrysoidine, etc. The weight of dye used should be from 5 to 15 per cent. of that of the rosin saponified. If the temperature is too low when the dye is added, or the soap solution is too concentrated, the color bases separate out as abietates, which must be prevented. The dyed soap solution is then precipitated with a dilute aqueous solution of a metallic salt. A slight excess of the lather should be added, as it facilitates the subsequent filtration and washing. The washed precipitate must be very carefully dried, as it is easily charred and spoiled by high temperatures.

The resinate colors got in this way are insoluble in water, more or less soluble in alcohol, and very soluble in benzole, ether, chloroform, oil of turpentine, wax, stearic acid, drying linseed oil, etc. They are very suitable for making varnishes for improving polished metallic surfaces, as well as wood, paper, leather, glass, etc.

In many cases, as for painting wood, for example, the metallic resinates which possess a color of their own, such as those of iron, chromium, copper, manganese, etc., are to be preferred, in combination with bismarck brown or other dyes, both from considerations of economy and from regard for fastness to light. By suitably mixing resinate colors dark browns and blacks can be got which can be used for printing or lithographic inks. Dilute solutions of the resinate colors in benzole can be used for dyeing textile fabrics light shades in a single bath, and the method is used very largely for silk, satin, and artificial flowers, and gives very fast results. The resinate colors are also suitable for dyeing and printing india rubber, celluloid, linoleum, and American cloth, as well as for dyeing white lead, zinc sulphide, heavy spar, chalk, and other inorganic whites. In paste form they are excellent for making colored pencils, and mixed with tragacanth, dextrine, starch, or albumen, they answer well in carpet printing. They can also be used for making brown asphalt varnishes black. Very little of them suffices, and the drying of the varnish is only very little hindered.

Dissolving the Oil Dyes.—This is done by stirring the dye into the fused fat. It is best to dissolve the dye in a little of the fat separately, and then to add the strongly dyed fat to the main mass. As above remarked, care must be taken to keep the temperature as low as possible. In dyeing soaps, the dye should first be dissolved in a little oil, and the same for dyeing leather. Very little dye is needed, as above shown.

To test the dyeing power of these dyes, it is best to proceed as with ordinary dyes, viz., to dye to a pattern in the production of which a known proportion of dye has been used. The results obtained are not so sharp as with ordinary textile dyes, but they are sufficiently so, and the trial should never be omitted. Fuse in a porcelain dish 20 grammes of stearine, and add to it a weighed quantity (0·01 to 0·02 gramme) of the dye to be tested. When it was fully dissolved, pour the stearine into cold water, so as to keep the cooled mass together, and not so as to let it spread over the surface of the water. This is best done by pouring out sharp from a height of an inch or so above the water. In this way patterns can be prepared which can readily be used for determining how much dye has to be used for producing any particular tint in a given mass of fat. Other methods can be adopted, but this is the one which has hitherto given the best results in practice.—Oils, Colours, and Drysalteries. From the Farben Zeitung.

A RAILROAD UP MONT BLANC.

The cost of the railroad to be built from the Arve Valley to within 1,150 feet of the summit of Mont Blanc, the highest mountain of the Alps, will be over $4,000,000, according to the Bulletin of the American Geographical Society. The projectors say it will be in operation at least four-fifths of the way to the top by July, 1903. A tunnel will be excavated, the lower entrance to which will be in the valley west of Chamounix. The tunnel will follow the upleading ridge on the left side of the Taconnaz glacier. Thus tourists will be carried up the northwest side of the mountain instead of the northeast side, the route followed by climbers from Chamounix. The tunnel will be a little over six miles long, with two or three openings to the surface on the route, where platforms will be built at points most favorable for viewing the scenery. At a height of 12,600 feet, where the tunnel will pass under the summit of the Aiguille du Gouter, a small hotel will be built. Thence the tunnel will be dug under the Rochers des Bosses to the height of 14,300 feet, where the terminal station will be erected. Sledges drawn by a cable will carry the passengers over the hard snow to the hotel at the summit.

JASPER R. RAND.

Jasper R. Rand was born September 17, 1837, in Westfield, Mass., of a family dating its American ancestry from 1635 and including two colonial governors; and which was well represented in the Revolutionary War. He obtained his education in the public schools and academy of his native town, and in Fairfax, Vermont.

His earliest business connection was with his father, who was a manufacturer of whips when Westfield was the headquarters of that industry. In 1865 his father retired from business, and Mr. Rand and his younger brother, Mr. Addison C. Rand, succeeded him.

In 1870 he removed to New York and was for a time associated with another brother, Mr. Albert T. Rand, President of the Laflin & Rand Powder Company. In 1872 Mr. Addison C. Rand began the manufacture of the Rand Rock Drills and other mining machinery, and the two brothers subsequently organized the Rand Drill Company, with Mr. A. C. Rand as president and Mr. J. R. Rand as treasurer, which arrangement continued until the death of Mr. A. C. Rand in March, which left the chief office vacant, when Mr. J.R. Rand was elected to the position. From small beginnings this business has developed into an important industry. When the Messrs. Rand became interested in Rock Drills, they were in the pioneer stage, with, at most, a small and uncertain future before them, but they have come to be an essential part of every mining outfit. Rock drills were among the first American machinery products to find recognition among foreign engineers, and they are to-day at work in nearly every country on the globe, where the mining industry has passed beyond the most primitive stage.

JASPER R. RAND.

He had a remarkable fund of wit and of pointed but stingless repartee, which made him the most delightful of companions—qualities which naturally brought him friends without limit. These and other qualities also made him a presiding officer under whose gavel it was a delight to sit. He was interested in all public enterprises and contributed generously to their support.

TYCHO BRAHE.

Outside Denmark the name of Tycho Brahe is, perhaps, not very familiar to any except those who are interested in astronomy, and yet his story, besides being exceptionally entertaining and original, has connecting links with several European countries, including England.

Tycho Brahe lived in the age of Frederik II., which is described in Danish history as the period of aristocratic autocracy — "Adelsvældens Tid." Himself a noble, he was content, or rather had the courage to turn all the advantages of his noble birth, besides the patronage which the king bestowed upon him, to the furtherance of the scientific pursuits which he loved so dearly, and to which with unceasing energy he devoted his whole life. As an astonomer his name cannot be ranked with those of Copernicus, his predecessor, of Galileo, his successor, or even of Kepler, who was his pupil; but I will not attempt to estimate the real value of the researches and discoveries of the astronomer, but rather confine myself to following the strange and romantic career of the man whom Denmark regards as one of her most illustrious sons, and who was described in his day as "the noblest of the learned, and the most learned of the nobles."

Both on his father's side and on his mother's, who was a Bille, he was descended from old and distinguished families. Otto Brahe, his father, was lord of Knudstrup, in Scaane, a district which is situated in what now forms the southeastern extremity of Sweden. Tycho, born in 1546, was the eldest son, and one of a large family of ten, but he did not derive any of the benefits during his childhood which companionship with his brothers and sisters would have given him, as he was adopted by his uncle, Jorgen Brahe, who, by treating him as an only son, and, no doubt, spoiling him, encouraged the development of an obstinacy and stubbornness of character which frequently showed itself in later years. Of his early childhood but little is known. It was his uncle's intention that he should be educated with a view to his obtaining some position in the service of the State. At the age of thirteen he was sent to the university at Copenhagen, where he studied philosophy, and showed great promise as a Latin scholar. In 1560 Tycho received what might be termed his "call" from the heavens. It came in the form of a solar eclipse, which roused the boy's interest to such an extent, all the more as he knew with what accuracy it had been foretold, that from that time his mind was made up, and he resolved forthwith to turn his attention to the study of astronomy. It is a curious fact that, ten years later, when chemistry had so absorbed him as to have caused him to neglect—nay, almost to have abandoned—his astronomical researches, he again received a sign from the heavens. This time it was the appearance of a new star, which he observed one night while walking from his laboratory, and which reminded him that it was really in that direction his dearest interests lay, and turned him again to the beloved pursuit of which he never wearied till his dying day.

But the idea of his taking up the science of astronomy was not favored or encouraged in any way at first. After he had spent three years at the Copenhagen University, his uncle sent him to Leipzig, where it was intended that he should study law. Anders Vedel, who afterward became one of his greatest friends, accompanied him now as tutor, and conscientiously endeavored to make Tycho devote all his attention and time to his legal studies. These obstacles, however, only served to strengthen his resolve. He had devoured the works of Ptolemæus as well as every other book he could obtain on astronomy, and at night, unbeknown to his tutor, he would creep out and begin his first intercourse with the stars. He soon found that astronomy was in no way the complete science he had at first supposed it to be, and accordingly he resolved to endeavor to lay a surer and more reliable basis for calculation, by establishing a greater accuracy in observations than then existed. For this he needed special instruments, and he at once began to have these constructed in Leipzig. We must not forget that the telescope was as yet unknown, and Tycho never conceived any idea of this sort, but, nevertheless, he appears throughout his lifetime to have displayed a marvelous ingenuity in inventing various instruments, which proved of the greatest assistance to him in his observations.

He was recalled to Copenhagen in 1565 by the illness of his uncle, who soon after died from the effects of a chill, the consequence of an attempt on his part to save the life of the king, who, while riding over from the island of Amager, was precipitated into the water by the collapse of the bridge. This sad loss made Tycho's stay in Denmark disagreeable to him. Shortly afterward, therefore, we find him in Wittenberg, benefiting by the excellence of the university and the general atmosphere of learning and cultivation which still impregnated the home of the great reformer, for it was hardly twenty years since the death of Luther. At Rostock, in North Germany, where he subsequently stayed for three years, an event occurred which shows us the impetuous nature of our hero. At a ball given by a certain professor, Tycho engaged in a hot argument with another young student; some say that it was on a question of astronomy; anyhow, the dispute was of so violent a character that, on meeting one another two days afterward in the street, they drew swords and fought. In this encounter part of Tycho's nose was slashed away by the sword of his opponent. This must have disfigured him more or less for life, but, according to the Danish biographer, he supplied the loss by "et stykke af sammensmeltet Guld og Sölv, hvilket han satte paa med Liim," a piece of gold and silver melted together which he fixed on with glue. The result must have been curiously uncomfortable.

At this time he had apparently no desire to return to his home; so he settled in Augsburg, where he was fortunate enough to find many scientific men interested in astronomy with whom he could associate and exchange ideas. Some of his most remarkable instruments, which quite surpassed anything that had been made up to that date, he invented and had constructed here, and he also gave directions for the construction of his famous celestial globe, which was intended to give an exact representation of the heavens, founded solely on his own observations of the fixed stars. This globe was four feet in diameter and covered with a coating of brass, on which the stars were engraved. Thus did the learned young Dane gradually become the object of general attention, and his reputation began to spread throughout the scientific world.

Otto Brahe, who was governor of Helsingborg Castle, died in 1570, and Tycho returned to Denmark to arrange his father's affairs. His uncle, Steen Bille, who was the only member of his family who really appreciated his worth or encouraged him, placed his house at the disposal of the young astronomer, who had an observatory erected and continued his work with his usual energy and persistence; but it was to chemistry that he directed the greater part of his attention, and the allurements of his laboratory would doubtless have absorbed it entirely had it not been, as I mentioned above, for the appearance of a new star that turned him again to astronomy.

His observations on this star formed the material for his first book. He was unwilling to publish it, however, as in those days it was considered beneath the dignity of a nobleman to demean himself by writing books; but two of his friends, Johan Pratensis and Charles Dancey (French Minister at the Danish Court) persuaded him to publish his observations, and he listened to them the more readily when he saw the ignorant and inaccurate accounts that had already appeared on the subject of the new star. The book, written of course in Latin, was prefaced by a letter from Pratensis persuading the author to publish it, together with his answer. Besides the observations on the star, which formed the greater part of the volume, there were astrological predictions on the coming eclipse of the moon. Then followed a poem—"Elegia in Uraniam"—in which Tycho expressed his disapproval at the absence of any real serious element in the lives of the nobles of that day. The volume con-

cluded with a poetical eulogy of the author composed by his friend Vedel. By this book his fame increased, and with it the number of his enemies.

The determination to leave Denmark for good he expresses in a letter to Pratensis, from which I will quote a few lines:

"Neither my country nor my friends keep me back; one who has courage finds a home in every place and lives a happy life everywhere. Friends, too, one can find in all countries. There will always be time enough to return to the cold North to follow the general example and, like the rest, in pride and luxury, to play for the rest of one's years with wine, dogs and horses (for if these were lacking how could the nobles be happy?). May God, as I trust he will, accord me a better lot."

In the sorrow at parting from his dear friend he says:

"Since in our separation we cannot blend the rays of our eyes together into one glance with which to regard one another, let us seek a point of union for our gaze in the bright star shining in the pure heavens above us. The star that I behold thou, too, wilt behold; though the earth separate our bodies, the heavens will unite our eyes."

He was not to leave Denmark, however, till the following year.

Curiously, like the modern fashionable intellectualism, the society of the Danish capital had become bitten with an intellectual craze, and astronomy was pronounced to be the fashion. Tycho Brahe was accordingly invited to give a course of lectures. He knew well enough that thirst for knowledge from such a quarter was merely a momentary fad, and consequently he declined at first, but to the King's urgent request he was obliged to accede, and the course of lectures was therefore given. One can imagine how glibly the belles of the Danish Court must have spoken to their cavaliers out hunting of constellations and planetary systems, and exchanged repartees in the phraseology of the higher mathematics.

At last, in the spring of 1575, Tycho started on his travels. First to Cassel, where he made great friends with the Landgrave Wilhelm of Hesse, who was himself a mathematician and astronomer of by no means the dilettante order. In Basle, Venice, Regensburg and Augsburg, where he stayed, much was to be derived from intercourse with prominent men, and from a near acquaintance with the latest discoveries in his own science.

Something must now be said of the important part played by the King of Denmark in this story. The first mark of royal favor was the offer of a prebend in Roskilde, to which was attached a certain income. This was in 1568, and as the astronomer's renown grew Frederik the Second began to show a real appreciation of his talents. For not only was he naturally proud that a subject of his should gain a world wide reputation, but at the same time he interested himself particularly in Tycho's work and was desirous of assisting him in it. The result was that the facilities given him and the favor shown him far surpassed in practical usefulness as well as in magnitude any patronage that has ever been granted to an artist or savant in history. The King's regard and admiration for Tycho are shown in many of the letters he sent conferring various honors and privileges. One of the royal letters might be given here as an illustration of the almost naif eagerness with which His Majesty desired to be kept informed in matters of astronomy:

"We, Frederik the Second, etc. Our favor as before. Know that the common folk say that again a large new star has appeared, and it may happen that this be one of the planets or another star, the rising of which is not known to the common folk. Therefore, we beg and desire you to explain to us whether any new star has come into the heavens, and bethink yourself of what planet or star it is that is wont to rise at this time. Thereby may our will be done. Actum Skanderborg, the 21st of September, 1578."

It was chiefly the Landgrave Wilhelm's praise and appreciation of the genius of his friend that induced Frederik to recall Tycho to Denmark, grant him a special allowance, and finally present him with the island of Hveen as his own personal property, with sufficient funds to erect on it whatever buildings he should desire. Before following my hero through the next twenty years, which constitute the period of his greatest prosperity and fame, I will endeavor to give some idea of the scene of his labor and of his magnificence as it appeared when all his projects had been carried into execution.

The island of Hveen is ideally situated in the narrow part of the channel of the Sound, not ten miles from Copenhagen. It is a rugged small island, only eight miles long and two miles broad, which seems to be guarding this narrow entrance to the blue tideless Baltic. On a raised eminence in the center of the island stood the famous Uraniborg founded by Tycho Brahe in the summer of 1576. The castle rose, with its galleries and turrets and gilded spires, from out of a cluster of fruit trees and flowers which shaded the walks and covered the terraces of a symmetrically arranged garden. It was built in red brick and white sandstone, in the so-called Dutch Renaissance style, like the palace of Rosenborg and other buildings in Copenhagen which were built some years later. The spacious rooms were filled with carved furniture and decorated with pictures and tapestries. In the stone passages lit by stained glass windows might be heard the play of fountains and the singing of birds. Over every doorway and niche were inscribed Latin verses and philosophical sentences. The upper floor was taken up chiefly by the banquet hall, called the Summer Room, carved and decorated with garlands of flowers. From the windows of this apartment a glorious view could be seen: to the east, the rocky coast of Sweden; to the west, the wooded shores of Sjælland, where here and there little seaside villages nestled in the beech woods; and toward the south, in the far distance, the towers of the capital, with numberless ships passing in and out of the harbor. A visit must now be paid to the chief room in the castle, which was situated on the ground floor on the west side. It was a circular vaulted chamber forming the library and museum, and contained a wonderful collection of books, curiosities and scientific apparatus. The giant celestial globe occupied one corner of the room, and in another was placed a curious astronomical clock. The walls were hung with the portraits of princes and great astronomers, under each of which an appropriate Latin verse was inscribed. Here it was that Tycho worked and discoursed to his pupils, and here he received his guests and would entertain them for hours by displaying his curiosities and explaining his instruments. Below this chamber in the basement was a vast chemical laboratory where he worked when the stars were hidden from view under a clouded sky. At all corners of the castle bells were hung for summoning the assistants and disciples who were lodged in the upper floor, or who, at the time, might be occupied with observations or the care of the elaborate instruments which were kept in the turrets and small observatories at the top of the house. Several buildings surrounded the castle; one was the residence of the assistants, another was a private printing office, and the smaller dependencies near the entrance gates were used as lodges and kennels. As an observatory Uraniborg was found to be inadequate; a few years after its construction, therefore, another building, Stjerneborg, was erected a short distance from the castle, and this was devoted entirely to astronomical requirements and was constructed in such a way as to allow space for the erection of gigantic quadrants and other instruments, and thus to give every facility to the astronomer and his associates for the most complicated observations.

In addition to this there was a special workshop on the island for the construction of mechanical instruments, and later on a paper mill was set up for the private convenience of the lordly astronomer.

Nothing certainly could surpass in completeness the arrangements on this small island, which, though far enough from the outer world to ensure tranquillity, was yet sufficiently near the capital to prevent the inconveniences of entire isolation. As Hammerton says in his Intellectual Life, "of all happily situated mental laborers who have worked since the days of Horace, surely Tycho Brahe was the happiest and most to be envied."

Let us now try to picture a scene for which the above description forms the setting. A cloudless night with the moon glittering on the sea round the island, in the far distance the lights of the city sparkle in the clear night air. Strains of music and laughter come from the summer room where Tycho and his guests are seated at supper. The laughter is caused by the jests of the dwarf Jeppe, who is crouching at his master's feet, from time to time receiving morsels of food from his hand. At the close of the meal a disciple comes down from the tower of the castle and announces that the night is clear. Soon from out the stone carved porch moves a small procession up to Stjerneborg. We can see the hurrying attendants, the bent forms of learned friends, the glittering figure of some distinguished guest, some prince with his suit, and in their midst we recognize the stalwart form of the great astronomer himself in doublet and ruff, his rapier at his side, his chain of gold round his neck, like some great ambassador accredited by the earth to the heavens, he is on his way to an audience with the stars. On they move to the terrace of Stjerneborg, and then pass down into the vaulted chamber which is inscribed: "Nec fasces nec opes, sola artes sceptra perennant." Here, when the guests have returned to the castle, the astronomer will pass the night rapt in contemplation of the mysteries of the universe.

What the peasants thought of Tycho may well be imagined. This man who doctored them and gave them medicines for nothing, who associated with princes and kings, foretold the future, spent night after night gazing up into the heavens surrounded by wonderful instruments. What did he see in those stars he knew so well, and which were but sparkling points in the vault of heaven? What mysteries did he read? Truly he was the wizard, the magician they had heard of in fairy tales.

Among the guests who visited the castle of Uraniborg were included great astronomers, mathematicians, philosophers, divines, princes, and kings. Queen Sophie of Denmark appears to have paid several visits, and on one occasion brought her father Duke Ulrich of Mecklenburg, with her. The visit Tycho would have appreciated the most—namely, that of the Landgrave of Hesse, with whom he continued to keep up an intimate correspondence on political as well as on scientific subjects—was unfortunately prevented by the death of Frederik II., in 1588. It was a year after her father's death that Princess Anne of Denmark set forth to the home of her betrothed, but owing to stormy weather was wrecked off the coast of Norway. The King of Scotland, therefore, who as a Danish biographer has it, "perhaps feared that the English Queen Elizabeth, who had already upset several of his plans for marriage, would do the same to this one," sailed forth to fetch his bride. The marriage was celebrated at Oslo on the coast of Norway, and in the spring of 1590 the royal couple came on a visit to Copenhagen. Thus it was that Tycho Brahe received a visit from James VI. of Scotland. The monarch who subsequently became so familiar a figure in the history of England, and is said to have been "a voluminous author on subjects which ranged from predestination to tobacco" (no doubt including astronomy, or, more likely, astrology), took the greatest interest in the learned Dane and his work. On leaving the island His Majesty asked what gift he should give the astronomer in return for his hospitality, to which request Tycho, with the true instinct of the courtier, replied, "Some of your Majesty's own verses." Nothing could have delighted James more; he readily acquiesced, and in addition accorded his host certain privileges for his writings in Scotland. Among the many other guests at Uraniborg are mentioned Daniel Rogers, Queen Elizabeth's Minister to the Court of Denmark, and Duncan Liddel, the Scotch astronomer.

Information respecting life on the island of Hveen is gathered for the most part from a diary which was begun by Tycho Brahe in 1582, at first only as a meteorological record, but subsequently became also a personal diary in which all events were recorded regarding the family and the visitors to the castle. Besides this, many of his letters, as well as royal letters addressed to him, have been preserved. The so-called "legend of Tycho Brahe," therefore, is as a matter of fact authentic history, although by reason of its very strangeness there is every excuse for pronouncing such a story as fabulous.

The striking personality of the astronomer is responsible in a greater degree for his remarkable career than any of the circumstances which may have been favorable or unfavorable to his ambitions. Such was his power of concentration and absorption that it is related of him, while on a visit to the Landgrave at Cassel, that even at the alarm of a dangerous fire in the palace, he could not be induced to leave his study until he had terminated the work with which he was occupied at the moment. Next to astronomy, chemistry took up a great part of his attention, and the cures which he dispensed to the poor for nothing were so much appreciated that the enmity as well as the envy of the doctors was soon roused against him.

He was, of course, on the first line as a mechanician as well as a mathematician, and he also appears to have occupied the post of architect to the king. Philosophy and natural science he taught to his pupils in addition to astronomy. As a writer, he had a great command of the Latin language, and his verses were much admired. He also seems to have loved music, if not played himself.

In appearance, the astronomer was a stoutly built, broad-shouldered man, of medium height, with a high forehead surmounted by short bright red hair. His mouth was concealed by a long thick moustache which curled over an auburn beard. In his portrait, he is represented with a stiff white ruff and black high-collared cape, around his neck the chain of the Order of the Elephant, which the king had given him. A great talker, he had somewhat overbearing and arrogant manners, and took little pains to conceal his contempt for the many whom he considered to be his inferiors intellectually. But with all his pride and conceit, there was nothing that was petty or artificial about him; his motto, indeed, shows the keynote of his ambition in his life of scientific research, "Esse potius quam haberi," to be rather than to seem.

It was only natural in such an age that a man who devoted himself to astronomy and chemistry should regard with equal reverence the study of astrology and alchemy, and that Tycho Brahe should have attempted to find a connection between the laws which govern circumstances and the laws which govern the movements of the heavenly bodies is in no way surprising, as many great men of his time shared his views. It is rather to be wondered at that in his astrological predictions he should have shown so much reserve and so great a dread of credulity and superstition, and that he should have kept astrology so entirely separate and independent from astronomy, the knowledge of which he knew could only depend on the truth and accuracy of his own incessant observations. As a boy, astrology naturally appealed to his strong power of imagination, and as early as 1566, when at Wittenberg, he wrote a poem prophesying that the death of the Sultan Suleiman would be coincidental with a coming eclipse of the moon. The sultan, however, died a few days previously, upsetting all his calculations. At the time he attempted to account for this, but when older he laughed at his boyish credulity.

While residing in Denmark he was commanded by the king to cast the horoscope of several of the young princes, which he did at great length and with great elaboration, but in every case he concluded with a saving clause, such as "The free will given by God to man is stronger than the heavenly influences." In a letter to the Emperor Rudolph II. on astrology, he says: "Of this I would prefer to say no more, as few know how to make use of it with proper caution and without falling into superstition and placing too great a confidence in it, such as never should be given to the discernments of any mortal." Nevertheless, he was himself superstitious by nature. If he met an old woman or a hare on going out, he took it as a bad omen, and would return home; and he would also listen with attention to the saws and prophesies of his dwarf Jeppe and often seriously ask his advice.

Of the astronomer's wife nothing has yet been said, and little, indeed, need be said. He married at the age of twenty-seven a poor peasant girl, by whose beauty he had been struck, and although there is no reason to suspect that his married life was anything but happy, it is clear that it must have been happiness of a very relative character, as his wife appears to have occupied an inferior position in his household, and in no way shared the intellectual interests of her lord and master. That he did not marry a lady out of his own society can be explained by the fact that no lady of that day would have submitted to so exacting and tyrannical a nature, or sacrificed herself to the exigencies of such an eccentric manner of living, and he himself doubtless would not have tolerated any woman who was not ready, more or less, to fill the place of a servant in his establishment. To a nature like his, it was, of course, a matter of entire indifference that such a marriage would be sure to give rise to the strongest disapproval in all quarters.

A series of unpleasant incidents, combined with the somewhat discontented and restless spirit which often showed itself throughout his career, caused, or rather forced, Tycho Brahe to abandon his life of magnificence and study at Uraniborg and again to leave his native land. This time it was to be for good. He had only himself to blame for this period of calamities, which must be regarded to a certain extent as his fall. The confidence he put in princes was in no way misplaced, for Christian IV. visited Hveen and continued to patronize one who had been so much favored by his father. But duties connected with the prebend of Roskilde were neglected, the peasants on Hveen complained of ill-treatment and oppression. Some of the allowances being stopped and his private fortune being exhausted by extravagance, he found himself unable to keep up his elaborate establishment; added to this, he was worried by a disagreeable lawsuit respecting the marriage of his daughter, disclosures with regard to his private life and religious views were circulated by his enemies, and his most influential friends and supporters at court had died or retired in the last few years. After a short stay in the capital, during which he waited lest the tide might again turn in his favor, Tycho Brahe reluctantly left Denmark and went to Rostock, where he made one last attempt to regain his position by addressing a letter to the king himself. The stern rebuke which he received as a reply from his royal master showed how his unpopularity had gained ground, and left him no hope of

being recalled into favor. Tycho then composed his famous poem lamenting over the ingratitude of Denmark, the first few lines of which I give in a rough translation:

Denmark, what have I done to thee, that thou shouldst thrust me from thy heart so cruelly?
How canst thou treat me thus with harsh indignity as an enemy to thee, my fatherland?
Have I not raised thee to fame and universal honor?
Canst thou now turn from me or blame,
Because my work has crowned with glory thy dear name!
Which of thy children has greater gifts bestowed on thee, my fatherland?
Canst thou now in anger chide me,
When in the vaulted dome of heaven
Thy name I wrote in glittering stars?
The day will come, my native land,
When thou wilt turn with love and praise thy son's immortal work, etc.

There is no doubt that he must have felt a keen regret at leaving his island, which, with all its wonderful facilities for study and research, had been his home at the time of his greatest prosperity. Of the costly buildings on Hveen there is at the present day hardly any trace to be found.

For a short twenty years only did the glories of Uraniborg last. No successor came to fill the vacant place. The lord of Hveen was banished into exile, the deserted castle was left in neglect and disuse to fall into ruins, and Denmark had to rest content with a mere memory while her illustrious son set out undismayed to sound the trumpet of his fame in foreign lands.

From the King of Denmark Tycho now turned to the Emperor Rudolph the Second, to whom he made such successful solicitations that after a year or so's wandering during which he published his most famous book, Astronomiæ Instauratæ Mechanica, he was finally received at Prague, and given the castle of Benatkè near by, where he established himself with his family, set up an observatory, and sent his son to Denmark to fetch his instruments. He rejoiced at finding a new home and at being so well received and graciously helped by the emperor, but in his heart he still yearned for his dear fatherland, and never did he forget his kindest, most understanding, and most munificent patron, King Frederik the Second. All this he expresses in a letter to his old friend Anders Vedel, who at this time had also fallen out of favor at the Danish Court, where he was a chaplain.

Among the disciples and assistants whom Tycho gathered round him at Prague was one who lived to gain a reputation as an astronomer which surpassed even that of his master. This was Johannes Kepler, who was then about twenty-eight years old. The close of the sixteenth century is a period of great moment in the history of the world's thought. What are now the most well-known facts, and the fundamental principles of philosophy and astronomy, were then being developed and fought for, for the first time, with all the ardor and enthusiasm which attend the discovery of new great truths, and were embued with all the freshness and vigor imparted to them by their first champions, who, while knowing that they must excite ardent controversy, were ready to suffer persecution—nay, even death—for convictions the value of which in the progress of human knowledge they knew could never be over-estimated. Both Kepler in his laws of the movements of the planets, and Giordano Bruno in his advanced conception of the solar system, were greatly indebted to Tycho Brahe for his profound and extensive observations respecting fixed stars, and his discovery with regard to the motion of comets. Tycho himself, however, was no great philosopher or thinker, and, having ensured accuracy in his observations and calculations, he made no attempt to go further with deductions and conjectures. His conception of the universe was retrograde when compared with the system of Copernicus. He took the earth as the center of the universe, and the sun formed the center for the orbits of the planets, but the sun itself, together with the planets moved round the earth. The system was thus a compromise between the Ptolemaic and Copernican. Whether it was religious scruples and fear of persecution which induced him to maintain this theory, or whether, as some say, not being able to improve on the Copernican system, his conceit induced him to elaborate something original which might bear his own name, it is difficult to say.

In 1601, at the early age of fifty-five, Tycho Brahe succumbed to a short but dangerous illness, and on his deathbed he solemnly entrusted his system to his foremost pupil, Kepler, in the hope that it might be handed down to future generations as marking an important epoch in the history of astronomy.

I will conclude by quoting a part of the oration which was pronounced over the grave at the close of the magnificent funeral which was granted by the emperor to the great Danish astronomer at Prague:

"In his words were truth and brevity, in his demeanor and countenance sincerity, in his counsel wisdom, in his deeds success. In him was nothing artificial or hypocritical, but he spoke his mind straight out, and to this no doubt is due the hatred with which many regarded him. He coveted nothing but time, and his endeavor was to be of service to all and hurtful to none."—Arthur Ponsonby, in The Nineteenth Century. Published by permission of the Leonard Scott Publication Company.

The Elbe-Trave Canal.—Consul Hill writes from Amsterdam, June 20, 1900:

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